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OPHTHALMIC LITERATURE

SUCCEEDING THE OPHTHALMIC YEAR BOOK

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See explanation on next page

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EXPLANATION

The OPHTHALMIC YEAR BOOK containing Bibliographies and the Digest of the Literature was established in 1904. OPHTHALMIC LITERATURE, containing the lists of current literature, was established in 1911. Both of these Journals were combined with other Journals in 1918 forming the American Journal of Ophthalmology, the Year Book portion being paged separately. In 1920 the Bibliographies and Digest of the Literature were published as a separate journal, OPHTHALMIC LITERATURE, quarterly.

This volume, continuous in numbering with the Year Book, will also contain the lists of "current literature," which have been heretofore published monthly in the American Journal of Ophthalmology. Subscribers who desire references to articles that have appeared subsequent to this issue, may, until the next issue appears, obtain them by applying to the Editor, 318 Majestic Building, Denver, Colorado.

The price for the two journals will continue as heretofore. The annual subscription price for OPHTHALMIC LITERATURE alone is SIX DOLLARS.

OPHTHALMIC PUBLISHING CO.

Toxic Amblyopias

Delamere F. Harbridge, M.D.

PHOENIX, ARIZ.

This section of the digest carries the literature from June, 1920, to July, 1921. For previous references see v. 16, 1920, p. 193.

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DIGEST OF THE LITERATURE

Experimental researches have established, contrary to former views, that the primary injury in this class of cases is not to the optic nerves, but to the layer of ganglion cells of the retina. **Schanz** in discussing the effects of light in toxic amblyopia thinks that this layer of the retina lying next to the vitreous is injured by light, the poisonous substances acting only as sensitizing agents. When the fundus is lighted uniformly, the central portion has a better chance for recovery than the peripheral, because of its better nutritive supply: while if the central area receives the greater part of the light, it suffers the more, thus producing in the one case a concentric contraction, and in the other a central scotoma.

Bachstez and **Purtscher** write concerning the increase in retrobulbar neuritis, including toxic amblyopia, as compared with the time before the war. In the two Vienna University clinics, the authors have compared the material of ten autumn weeks of the year 1919 with the corresponding period of the year 1913, in all 2976 cases in 1919 compared with 2901 cases in 1913. They found that the percentage of cases with retrobulbar optic neuritis rose from 0.8% in the year 1913 to 2.1% in 1919. They make out the tobacco amblyopias (reckoned upon the total number of neuritis cases) to be 79% in 1913 as against 53.1% in 1919; the cases due to multiple sclerosis 8.3% as against 6.2%; the cases due to accessory sinus disease 4.2% as against 4.7%; the incompletely examined cases 8.3% against 17.2%.

In addition, two new groups were found in 1919; one of unknown etiology formed 11%; in which in spite of searching examinations, a cause could not be ascertained; a second group of 7.8% in which a connection with war exhaustion appeared possible in the opinion of Uhthoff-Szymanowsky. The tobacco amplyopias in 1919, in spite of smokers' cards in Austria and in spite of high smugglers' prices were noticeably more numerous than the total number of cases of retrobulbar neuritis in 1913. The cause of this marked increase was not established (toxin producing material in many forms of the tobacco ingredient, in tobacco distillation?).

The authors believe also that there was an increased predisposition as a result of atrophy of the surface fat thru chronic undernourishment. The increase of the number with undetermined etiology might possibly also stand in the same class with those of deficient nourishment, in the sense of an increased predisposition. In regard to the group with war etiology, the authors do not believe, on the basis of their own material, that they are authorized to conclude that there is a special war form of retrobulbar neuritis. These cases should properly fall in the group of unknown etiology.

TOBACCO AMBLYOPIA.—**Pagniez,** reports a patient with transient tobacco amaurosis. The case was peculiar, in that the color of the iris changed likewise during the weeks of the amblyopia. For several years the young man had mild albuminuria, not above 0.5%. Blood pressure was normal. Vascular spasm in the eye would explain the amblyopia and the modification in the color of the iris, which became much yellower. He is a great smoker, and recently had an attack of angina pectoris of the tobacco spasm type described by Huchard. In the discussion that followed, Laubry stated that he had seen with his own eyes the onset of the spasm of the retina responsible for the transient amaurosis in a case of lead poisoning. He has recently had a patient whose attacks of intermittent claudication did not return after the young man gave up smoking. The spasms in these cases are like those responsible for extrasystoles, suggesting angina pectoris, from abuse of tobacco. **Underwood** and **Reeves** discuss the effects of smoking on visual acuity in the air service.

Finlay reports the clinical history of a case of recurrent chorioretinitis in a man aged 53 years. The unique feature was the successive production of the same ocular lesion by a multiplicity of causes; in the first two attacks by an intoxication with tobacco, in the next by an intoxication of intestinal origin, in the fourth by septic absorption from an apical tooth abscess, and in the last attack again by an intestinal autointoxication. The possibility of all the outbreaks being brought about by this latter cause can be excluded by the rapidity with which the visual disturbances responded to treatment, not taking this into account in the other instances. To the author's mind, this can only be explained by some local lesion affecting the macular regions of the patient, affecting their metabolism or making their nutrition difficult under the slightest variation from normal of its vascular supply, and especially susceptible to certain toxins or poisons, the disturbances being at first purely functional. Arteriosclerosis is most probably at the bottom of the whole process.

METHYL ALCOHOL AMBLYOPIA.—**Harboe** reports a case of methyl alcohol intoxication and blindness, in which the man was under observation for a week before the cause of the disturbances was discovered, the man denying drinking liquor. The bottle from which he had imbibed was finally found and still contained some of the "spirit" which proved to be pure methyl alcohol. He could count fingers at half a meter with the right eye, and with the left detect screening of the light at some distance. The visual field was much restricted. Nine charts of the fields are reproduced showing the gradual improvement. By the end of four months there was still some paresis of accommodation. There were no signs of the usual retrobulbar neuritis at first, but some trophy of the optic nerve finally became evident. Treatment is usually lavage of the stomach and enemas, with measures to induce diaphoresis. In conclusion, Harboe cites the literature on poisoning by wood alcohol, and mentions Kafka's report in 1919 of eleven cases of retrobulbar neuritis in which exclusion of all other causes seemed to point to this.

A case of acute amblyopia due to methyl alcohol is reported by **Mongel.** A male aged 21 years, took within twenty-four hours, six drinks of supposed whisky. Within thirty-six hours he awoke without light preception. When observed twelve hours later there was present a severe, wide spread, toxic neuroretinitis. The edematous cloud extended well outward from the nerve into the adjacent retina. Veins were very dark, engorged and tortuous. Eliminative, supportive and alkaline treatment was administered. Within six days, vision was 20/20, and in nine weeks 20/30. The author concludes: 1. That methyl alcohol produces in the optic nerve and retina the same destruction which characterizes the intake of other toxic agents. 2. It is much more dangerous owing to the product of oxidation, formic acid, being also a poison. 3. The specificity of its toxic action may be manifested as neuroretinitis or a retrobulbar neuritis. 4. The acute amblyopia is probably an interstitial inflammation of the optic nerve associated with an intense edema, nature trying to neutralize and dilute the poison. 5. Those cases in which pressure is allowed to persist or the toxic action is specifically on the ganglion cells, are represented clinically by an absolute central scotoma, these are hopelessly blind.

Hurst observed a man, aged 47 years, five days after ingestion of a large quantity of methyl alcohol. No light perception in the right eye; fingers at three feet, in the left. The media were clear, the fundus showed a neuroretinitis. Under the usual treatment vision improved to 6/60 with normal color vision, but much contracted visual field, especially for red. Upon returning to work, he was unable to distinguish the flame of a 100 C. P. electric light. Notwithstanding the fact that the patient remained intoxicated a large part of the time, seven months later vision in the left eye was 6/6 with contracted fields; the right, fingers at 3 feet.

Suker, presented a young man, who with three others enjoyed a methyl alcohol debauch. The other three died. When the young man was brought to the hospital, he had vision in each eye limited to hand movements. Spinal fluid and blood Wassermann negative, and yet salvarsan given in intensive doses and at relatively short intervals, restored vision in each eye to 20/30. When able to take visual fields, no positive central color scotoma was obtainable, but only a central relative scotoma for color and form, for about 15° was obtained. The discs, six weeks after the debauch, did not show any distinct evidence of atrophy, tho there was a moderate temporal pallor present in each. Whether or not the salvarsan injections had any direct effect in producing this rather good end result was not fully determined; and, still one could not altogether deny the influence of the arsenic and salvarsan upon the socalled retrobulbar optic neuritis. Free elimination with sweatings were the only other measures employed.

Zethelius and **Wersen,** report the clinical histories of seven cases of methyl alcohol blindness, treated with lumbar puncture. Their course was much more favorable than usual. In four of the cases, vision which was very much diminished became normal or about normal. Others regained after complete or almost complete amaurosis considerable vision, which remained unaltered after a long observation. In four cases vision was considerably improved immediately after lumbar puncture. In two, the sight became better after each of the repeated punctures.

The prohibition, introduced into Russia at the beginning of the war, led to the consumption of sarrogutis and adulterations of brandy, mostly by methyl alcohol. The use of these agents resulted in many deaths and sudden blindness. **Goldflam,** observed eleven cases. Those who consumed from 200 to 260 ccm. generally died, while the majority, after ingestion of 40 to 80 ccm. presented visual disturbances. These were bilateral, occured rapidly, large immovable pupils and normal eye ground. This was followed several weeks later by scotoma and blindness. Transient improvement of sight occurred followed by permanent impairment or loss of vision due to atrophy of the optic nerve.

Compared with other intoxications, the intoxication by methyl alcohol resembles closely amaurosis from felix mas, which however, does not cause a central scotoma. The prognosis is very bad. If vision is once impaired, there will be no return to normal, on account of consecutive descending atrophy of the optic nerve. The often present scotoma indicates the early involvement of the ganglion layer of the retina. The primary affection invades the whole intraocular portion of the optic nerve.

Those patients, who freely vomited spontaneously or by irrigation of the stomach, fared best as to vision, even if several hours had elapsed after consumption. Methyl alcohol could be detected in the organs of cadavers as late as from 48 to 72 hours after ingestion. In later stages diaphoresis thru aspirin, moist, hot, and electric baths, seemed useful. But an essential influence on the pathologic process in the optic nerve cannot be expected.

Blegvad, has encountered thirty-two cases in the last year or two, in which central amblyopia had developed sooner or later, up to several months, after beginning to drink a little "Kogesprit" daily in place of the more expensive customary brandy. Vision had been reduced by nearly 75 per cent, in twenty of the eyes the papilla was more or less blanched, and in thirty-four, there was a tendency to atrophy, while scotoma for red and green or blue or white was common. The patients had all applied to be fitted with glasses, as they could not see to read. **Fuchs, Birch-Hirschfeld,**

and **Steindorff,** each contribute to the subject of methyl alcohol amblyopia.

QUININ AMBLYOPIA. — **Wunderlich,** contributes to the subject of quinin intoxication and its pathogenesis, with report of a case. A girl, aged 24 years, after taking 8 grains of quinin, suddenly fell sick with vertigo, tinnitus, vomiting, diarrhea and loss of consciousness. The next morning, she was completely deaf and blind. Five days later, she was brought to the clinic: Vision, R. = 5/15, L. = perception of light, maximal mydriasis, retinal vessels normal, slight peripapillary edema, optic discs of normal color. Vision and visual fields gradually improved, so that at her discharge R., was 5/5; L. 5/20 (impaired by a scar on the cornea). At the same time, the retinal vessels grew smaller and the discs became white, the palpebral fissures were wide, mydriasis persisted with slight reaction to light, visual field contracted, hemeralopia.

From the author's observations in this case and a discussion of the literature, he, reached the following conclusions: Quinin is a strong protoplasm poison, which attacks with predilection the ears and eyes. It primarily damages the nervous elements of the eye, as in the above case; the ganglion cells, inner granules, neuroepithelium, optic fibers, perhaps also the central ganglion. It irritates the sympathetic causing mydriasis, insufficient reaction of the pupil, ischemia of the retinal vessels, and damages the vascular muscles. After longer persistance of ischemia, secondary lesions of the nervous elements and anatomic alterations of the vessels, perivasculitis and changes of position occur. The phenomena of optochin poisoning are analogous and due to the same pathogenesis.

Rathery and **Combessedes'** patient accidently took 18 powders of 0.5 quinin sulphat, and several hours later became blind. This amaurosis is not a true amaurosis, but forms a special class in the toxic variety. A central scotoma with preservation of the visual field is not present; but the special symptoms of extreme contraction of the visual field with preservation of central vision, mydriasis for a long time and early changes in the papilla and blood vessels appear.

Bollack, examined the fundus of a patient, fifteen hours after ingestion of four grams of quinin and nine hours after the beginning of bilateral blindness. There was a slight pallor of the disc with normal vessels. In twenty-four hours this had disappeared with recovery. Twenty hours after the ingestion of the quinin, the retinal arterial tension was R. 55.9, L. 45.9. The next day it was R. 35.95, L. 35.85. The fifth day it was R. 30.65, L. 30.60. Quinin amblyopia with unusual field defects, is reported by **Kjolbye.**

LEAD AMBLYOPIA.—**Gibson,** in discussing papilledema in ocular plumbism states: that lead poisoning in children is apt to induce an oversecretion of cerebro-spinal fluid, as his cases prove; that this oversecretion is due to increased activity of the choroid gland seems likely. Whether lead in circulation causes this oversecretion indirectly by means of a brain extract, or by direct stimulation, cannot be very easily decided. That lead does not excite the choroid gland to secrete, but induces the fundus changes thru the intervention of the kidneys, if accepted, could not explain the fact that the plumbic cases we see in children do not exhibit albuminuria or other evidences of kidney disease, and that the fundus changes are those of papilledema and not optic neuritis. Professor Mills, is right in stating that the fundus appearances of ocular plumbism are identical with those of cerebral tumor. He may be right in considering that lead acts indirectly on the choroid gland, as he thinks tumor growth does. In the case of plumbism, however, we have lead circulation in the blood, as is proved by the fact that it is to be found in the urine and that it often leads to a blue line of sulphid of lead in the gums.

Barrett, in discussing Professor Mills contribution, calls attention to some out-standing difficulties in the mechanical explanation of all cases of optic neuritis or papilledema. Of the three types; old choked disc, the type dependent on renal disease, and the type met with in syphilis, if all are due to the same cause we should expect to find transition forms.

Blaxland reports an unusual case of toxic amblyopia due to lead. The patient complained of a dark area in front of the right eye, of four months duration. V=6/24, no muscular paresis, the disc and macular region normal. There was a large central scotoma. A toxic history of any kind was denied. Teeth sound, but there was a mild gingivitis. The reporter was suspicious of lead. A week later the patient stated that he had been using for years white lead and linseed oil as a remedy for piles. Within a month the vision improved and the scotoma lessened. The case is of interest owing to the absence of papillitis or gastric colic and the unilateral nature of the lesion.

BARIUM AMBLYOPIA—**Garraud** and **LeRoux,** report a case of bilateral retrobulbar optic neuritis, consecutive to the ingestion of sulphat of barium. The patient, aged 70 years, was seen on March 19, 1920, suffering from slight conjunctivitis; his sight was normal, and there were no ophthalmoscopic signs of disease. At 11 o'clock on May 12, 1920, he was given 125 grams of sulphat of barium for a radioscopic examination of the stomach. Two hours later he found his sight was "disturbed," and he was giddy. At the same time he was attacked by a severe colic and diarrhea. At 6 o'clock, seven hours after his dose, severe vomiting ensued, lasting for half an hour. He was then seen by his ordinary medical attendant.

The failure of vision was progressive during the next three days, so that the patient was unable to read even very large print. At the end of the third day improvement of sight began and slowly continued. He was first seen by Garraud and Le Roux on May 24, twelve days after the administration of the barium salt, when they noted; right eye; no surface inflammation; pupillary reflexes undisturbed; no appreciable lesion in media or fundus; field of vision normal, V=8/10. No conjunctival congestion; pupillary reflexes present; media clear; partial decoloration of the optic papilla and narrowing of its arteries; no visible changes in the macular region; field of vision unrestricted; central scotoma, with slightly eccentric fixation, V.=7/10; urine normal. June 2, vision improved; R.=9/10, L.=8/10. The central scotoma had almost disappeared. June 14, complete recovery; R. V. 10/10, L. V. 10/10. Left optic papilla has regained the appearance of health.

In Garraud and Le Roux's case, the barium sulphat was proved to be free from adulteration by lead, but no tests were made for other salts of barium. These cases show that care should be taken by those employing this preparation to ensure that "chemically pure sulphat of barium, for administration for radioscopic examination," is supplied.

ARSENIC AMBLYOPIA.—Arsenic neuroretinitis is discussed by **Petren** and **Ramberg,** and **de Haas** observed changes in the nails of patients with optic neuritis due to arsenic poisoning. The New York Medical Journal takes up the ocular accidents due to arsenic products.

CARBON MONOXID AMBLYOPIA.—A general resumé of the subject of carbon monoxid poisoning is contributed by **Wilmer.** An excellent description of the subjective and general nutritional effects, as well as the ocular findings of poisoning by this agent is given. The author points out the distinct tendency of the poison to cause neuritis and especially affect the optic nerve. Forty references, two case reports and illustrations accompany the article.

The first case report details very graphically, the subjective and general effects upon an entire family. One member, a boy aged 8 years (four years after he had been taken from the poisoned house) was examined by the author. The muscle balance and central vision were normal. The central color vision was very acute, but the peripheral form field was contracted to about 25°. The patient was observed occasionally during the ensuing three years, showing definite improvement of the peripheral fields. There developed, however, large paracentral scotomata. The essayist's second patient was a man aged 35 years, who suffered greatly reduced vision following the use of a gasolin torch in a closed room, V=13/200, and 20/200, color sense very defective. Fields reduced. The author concludes, by stating, that the exposure in modern life to the influence of carbon monoxid, introduces an additional cause of eye lesions. As carbon monoxid is present in all the gases connected with domestic and industrial activities, it has possibly been responsible for certain obscure amblyopias that have been attributed to other often quoted chemical substances, and its causal relation may be obscured at times by some other very evident source of toxemia, such as septic tonsils, apical abscesses, syphilis, etc.

WAR GAS POISONING—**Oswald** reports disease of the vascular system in a man aged 34 years, after inhalation of war gas; which led to gradual closure of the afferent blood vessels of the retina, with subsequent degeneration of the inner retinal layers and complete amaurosis of the left, and almost complete amaurosis of the right eye. According to the anatomic investigations of Anhoff, inhalation of war gas causes easy coagulability of the blood, increased viscosity and subsequent retardation of the blood current as etiologic elements for thrombosis. The damage to the endothelia by intense immigration of leucocytes into the vascular walls is considered as an instant effect of the poison. The possiblity of thrombotic closure of the capillaries and precapillary arteries was ascertained by these investigations: A pathologic factor may be intense contraction of the blood vessels thru irritation of the motor center of the medulla oblongata. The character of the ocular arteries as terminal arteries explains why they are chiefly affected, because interruption of circulation immediately produces functional disturbances, not noticeable in other organs.

BERI BERI AMBLYOPIA—**Oguchi** in discussing the differentiation between beri beri and toxic amblyopia, states, in both diseases central scotoma is present. In retinitis centralis the sense of yellow is weakened, while in beri beri amblyopia, green is chiefly affected. The author believes that in retinitis a light exudate is overlaid upon the macula lutea, which lying before it, absorbs yellow color.

IODOFORM AMBLYOPIA—**Kagoshima,** observed in a boy, aged fifteen years, who was treated by a physician surgically with iodoform, a disturbance of vision, in which the fundus showed a slight neuritis, and the field of vision showed a central scotoma. In connection with this, the case had a slight paralysis of the oculomotor. The urine showed a strong iodoform reaction. In the course of convalescence the central scotoma showed at times a break upwards, as we often observe in alcohol amblyopia.

MACULI AMBLYOPIA—**Akazuki,** reports a case of retrobulbar neuritis caused by *maculi.* A child of eight years had acute diminution of vision, after she had taken a very popular remedy (maculi, a sea weed), against ascaris. Fingers could only be counted at one meter. The pupils were slightly enlarged, the reaction sluggish. Fundus normal, the veins only slightly enlarged. The vision became normal after a week.

A case of visual disturbances after *eucopin,* is reported by **Franke** and **Hegler.** **Santos Fernandez,** discusses the diagnosis of toxic amblyopia. A case of amblyopia from carbon bisulphid is reported by **Terrien.** **Mohlau** reports two cases of *dimethyl sulphat* poisoning.

The Optic Nerve

WILLIAM T. DAVIS, M.D.

WASHINGTON, D. C.

This section carries the literature from August, 1920 to August, 1921. Closely related topics will be found in the section on Visual Tracts and Centers. For previous references see O. L. v. 16, 1920, p. 203.

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DIGEST OF THE LITERATURE.

ANATOMY.—To demonstrate the anatomy of the optic nerve **Fuchs** used sections transverse from various distances behind the nerve head. One in the region where the central vessels enter the nerve showed the fasciculi of nerve fibers surrounded by the septa which united to form a thickened layer on the inner surface of the pia mater. Some of these sections were stained to illustrate the subdural and subarachnoid spaces, in which were seen rounded corpuscles similar to those found in the central nervous system, which have no known physiologic or pathologic significance. A section about the posterior surface of the sclera showed the central depressed part of the lamina cribrosa in which the nerve fibers are smaller and transparent, having lost the myelin sheath. A section thru the nerve head showed the physiologic excavation with transparent fibers around it that permitted a view of the scleral vein. Other sections showed anomalous variations including one of fold in the retina.

ANOMALIES.—**Wick** discusses *coloboma* at the entrance of the optic nerve. In a case mentioned there was great diminution of vision and divergent strabismus of twenty-five degrees. There was concentric limitation of the field for white and colors; green was

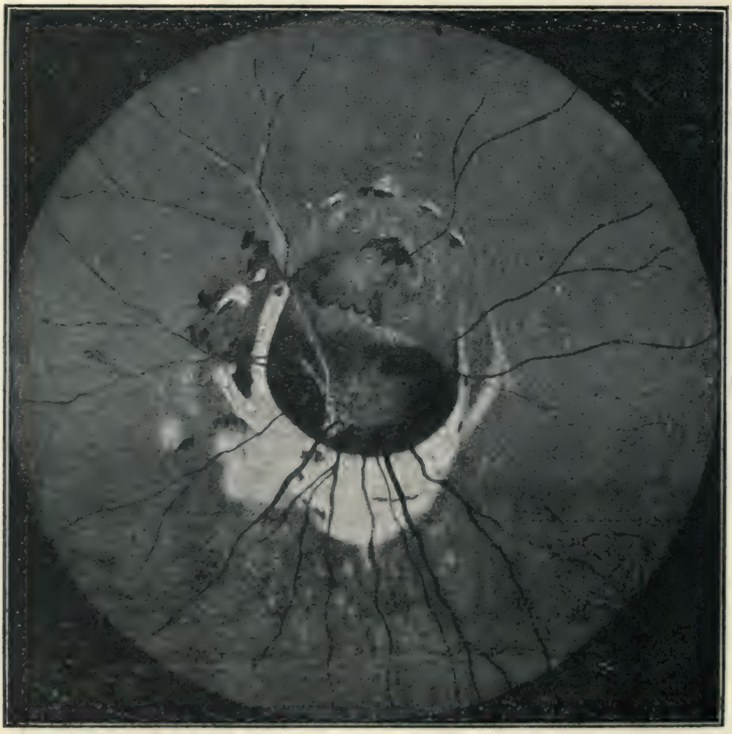

Fig. 5. Coloboma of optic nerve entrance. Wick's case, showing excavation 5 D. in depth, from which the retinal vessels emerge.

not recognized. The papilla was not visible; in its place was a funnel shaped excavation of grayish-red color (Fig. 5). Thirteen blood vessels proceeded from this funnel. Some of these vessels were sheathed by a grayish blue tissue. This vascular funnel passed without limit into the neighboring portions and was surrounded by a grayish oval. There was a gray particle of tissue over the vessel margin of the funnel. The funnel was five diopters in depth. A general history of these deformities with literature on the same is given in detail.

VENOUS PULSE WITH EXTRA SYSTOLE.—In examining a man of 34 recently suffering from influenza, **Ascher** found in the right eye a marked venous pulse which occasionally became irregular thru a prolonged and excessive filling of the central vein. On comparing it with the radial pulse it was found that these irregular pulsations were synchronous with an extra systole. This was afterwards confirmed by studies with the electrocardiograph. Ascher finds no similar case on record.

ETIOLOGY OF OPTIC NEURITIS.—**Garcia del Mazo** mentions a case of bilateral optic neuritis following *suppression of menstruation* in a woman of thirty-three with a normal history. She was menstruating when she was informed that her husband had been killed. There was a sudden suppression of menstruation and fainting. On recovering consciousness she had headache and dimness of vision. Shortly she had not even light perception. In several months menstruation reappeared. After a year he saw her. There was a double atrophic optic neuritis. Treatment was of no avail.

In a second case in which the previous history was normal, the woman, while menstruating, suffered a severe emotional disturbance. When he saw her she was anemic, complained of headache and faulty vision. Ophthalmoscopic examination showed double optic atrophy.

Dumalard, Aubry and **Toulant** report on ocular signs of *acute epidemic encephalitis* and a case of bilateral papillary stasis. In this case the ocular signs appeared very slowly. On the twenty-sixth day of the disease, the pupils became sluggish. In three weeks papillary stasis was observed. The retinal veins were engorged and the physiologic cup was not observable. A typical papillary stasis became evident later. The eye symptoms of encephalitis were observed. Numerous other cases are described by Morax and others.

Four cases are reported by **Symonds** in which optic neuritis was associated with signs of wide spread lesions of the nervous system. If the definition put forward by Barker, Cross and Irwin (O. L. v. 16, p. 312) be accepted, the clinical signs of all four cases are consistent with the diagnosis of *lethargic encephalitis*. In one case the Wassermann was feebly positive, in the others negative. Symonds states that the association of optic neuritis with acute disseminated myelitis is an involvement of the optic nerves in a diffuse inflammatory process affecting the nervous system, analogous to the association of optic neuritis with lethargic encephalitis.

Urbantschitsch reports a case of repeated bilateral neuritis. The patient had influenza; following this he became sleepy and had headache and fever and an otitis media. There was left abducens paralysis and bilateral optic neuritis. This improved and the fundi became normal. Again there appeared headache, with vomiting, papillitis and swelling of the disc in about three weeks. Mastoiditis developed which required an operation. In several weeks the papillitis decreased and disappeared. In a month, headache and vomiting occurred with reappearance of papillitis. Lumbar puncture showed increased pressure with a clear fluid. Papillitis again disappeared to reappear in a marked degree in about one month and finally disappeared and the patient became well. The writer thinks the condition causing the papillitis was encephalitis lethargica.

Santos Fernandez mentions a case of optic neuritis following *marriage*. Hysteria was excluded. It was provoked by excitement of the sexual apparatus. Sixteen years after this, the vision had diminished considerably. Ophthalmoscopic examination showed atrophy of the papillae. The beginning of this condition was probably a retrobulbar neuritis. Her general condition was poor. Finally a diagnosis of generalized arteriosclerosis was made. She died at thirty-two years of age. A second case is mentioned of a young girl who suddenly broke her relations with her lover. This was at first thought to be a case of hysteria but she developed an optic neuritis with atrophy. This atrophy was believed to be a result of changes in the menstrual function.

Terrien in writing of the optic nerve in the meningeal reactions describes the anatomic relations of the spaces of the brain membranes and those of the optic nerve. The cerebrospinal fluid extends as far as the lamina cribrosa. Papillary stasis is accompanied by ventricular dilatation, either localized in the third ventricle or generalized. The former plays an important role in the stasis. The dilatation of the ventricle in tumor of the brain is caused by the interference with the flow of the cerebrospinal fluid from the ventricles. Dilatation of the ventricles brings on the stasis of the papillae. This stasis is never inflammatory as it is of mechanical origin. It may, however, be accompanied by neuritis but this does not exist at the beginning. The affections of the optic nerve in the meningitides are also found in the neuritides. The symptoms are those of a typical neuritis. There is pain on pressure. The fields follow closely the changes in the nerves.

Three classes of optic neuritis may be distinguished: 1. Axial; 2. Total, and 3. Peripheral. The meningeal coverings may be involved, in which case we have what is called an optic meningitis.

Besides the affection of the nerve by continuity, we should consider the circulation of the cerebrospinal fluid, the lymphatic circulation in the pia and the perivascular circulation. The nerve bundles are affected by the circulating toxins in this way. The initial lesions are always first in the nerve sheaths, a true perineuritis. It is truly interstitial at first. A fibrous sclerosis takes place, later a degeneration of the nerve fibers occurs.

The descending neuritides may be seen in many affections and intoxications; as, parotid infections, influenza, diphtheria, lead, iodoform and all varieties of meningitis. An optic meningitis has been observed in many conditions such as dental caries, nasal accessory sinus infection, the acute infections, etc. In some cases no cause can be found. In some cases it is due undoubtedly to an acute meningeal episode from some cause. A lumbar puncture gives the most important data.

The optic atrophy of childhood, so often seen, must be due to an optic meningitis. The symptoms depend on the meningeal reactions around the optic nerve. According to these reactions the symptoms are: 1. Hyperemia of the papillae; 2. Optic neuritis; 3. Optic neuritis with stasis; 4. Meningeal congestion only.

This last is usually the first change and is often unobserved, passing rapidly into optic neuritis. It should be carefully sought for in the early stages of paresis accompanied with slight interference of the accommodation. It is the alarm signal. With the direct ophthalmoscopic image, the disc is finely punctate, the edges still clear; later these are hazy. The ophthalmoscopic appearances in optic neuritis are described. The periphery of the visual field is primarily affected on account of the meningeal covering of the nerve being involved. The patient is often unaware of this symptom. Concentric contraction of the fields, particularly for colors, is most often seen. Depending on how much the pial sclerosis extends into the nerve proper, the symptoms are greater or less. The fields may be limited in sectors or in a cuneiform manner, depending on the way in which the sheaths of the nerve are affected. Hemianopsic limitations may be seen in basal meningitis.

Shimazu in an article concerning neuritis caused by inflammation of the anterior part of the eye says in the presence of such an inflammation a reduction of the visual acuity takes place which is coupled with disease of the retina and optic nerve.

With bacteria the author caused an inflammation in the anterior part of the eye. He found, after four days, in the enucleated bulb, a degeneration according to Marchi in the optic discs and also in their vicinity and in the retina, especially beside the central blood vessels in which no change was seen with the hematoxylin and eosin stain.

In the bulb, enucleated after twenty days, the optic disc was plainly swollen, and in the vicinity of the disc more round cells and fibrinous exudates were visible. In the optic nerve, but somewhat removed from the disc were also found the granules of Marchi which were not visible, however, because of their distance from the optic disc. According to the author the cause of degeneration depends mostly upon the toxins.

OPTIC NEURITIS WITH NASAL DISEASE.—**Von Eicken's** paper is chiefly a review of the literature. The percentages of eye diseases due to nasal conditions, according to the authorities, vary from 0.006% to 0.312%. It is very difficult to make the diagnosis of rhinogenic optic neuritis on account of the presence usually of other etiologic factors. Only when all of these are absent can the diagnosis be made with certainty. The bibliography gives the cases not included in Brückner's paper.

Finnoff presents a case having transitory attacks of blindness over a period of a year. The discs were swollen seven diopters. Examination and laboratory findings were negative with the exception of a questionable Wassermann which after the provocative test proved negative. There were also three root abscesses. Antiluetic treatment and removal of the infected teeth were of no avail. Exenterating the posterior ethmoids improved the condition but did not cure it.

Ellett in his dissertation on optic neuritis and associated diseases of the nasal sinuses remarks that ocular disease appears to arise from nasal disease in one of two ways, either by absorption of the toxins from a focus of suppuration or by contact. The close relation existing between the sphenoid sinus and the optic nerve is well known. One-third of the one hundred skulls examined by Francis and Gibson showed the nerve and commissure to be separated from the sphenoidal sinus by a thin paper-like bony wall measuring one-fourth mm. in thickness. Actual dehiscences often exist. Under these conditions there may be retrobulbar neuritis and less often neuritis with changes in the nerve head.

The visual changes vary from enlargement of the blind spot to a loss of light perception. There are changes in the color fields, especially color scotoma.

The ocular lesion from posterior ethmoidal and sphenoidal sinuses is practically always involvement of the optic nerve which is not often the case in affections of the anterior sinuses.

The number of affections of the eye in a given number of cases of nasal and sinus disease is small. The oculist is the one who sees these on account of the eye symptoms. The sudden onset of the eye symptoms and their as sudden disappearance on relief of the nasal conditions is striking.

There is great difficulty in arriving at a diagnosis of posterior sinus disease and repeated examinations may be necessary.

Marin Amat reports a case of optic neuritis with amaurosis and rapid cure with *parenteral injections* of milk. The patient was a lady aged forty-four years and married. She suffered from hemicrania very severely. She began to have hazy vision of the left eye which became rapidly worse. In four days the eye was blind. The examination of the eye showed dilated pupil not reacting to light. Consensual reaction was present which is a sign of true amaurosis. The disc was swollen and the retinal vessels were dilated and tortuous and showed perivascular exudate. The right eye was normal. The patient had had grippe following which she had the described headache. There was a profuse discharge of pus from the left nostril. There was a left sphenoidal sinuitis. She was given four cc. of goat's milk subcutaneously which was repeated five times on five consecutive days. Later two more injections of three and two cc. were given. Complete recovery took place.

SYPHILITIC OPTIC NEURITIS.—**Lacroix** and **Fontan** report on syphilitic optic neuritis and neosalvarsan. Two groups were observed: (1) Simple neuroretinitis; (2) Retrobulbar neuritis.

Six cases are reported. Special remarks are made on: (1) Treatment; (2) Results obtained; (3) Accidents observed.

(1) Treatment was given only after being sure that the renal and cardiac systems were intact. During the neosalvarsan treatment, daily injections of 10 mgm. of mercury cyanid were given for ten days. There were two to three series of ten injections each, separated by periods of ten days of rest. One or two series of injections of neosalvarsan were given beginning with gm. 0.15; rarely they gave beyond gm. 0.6. Rest of fifteen days is then given.

(2) Five cases were cured and one resisted treatment.

(3) There were no grave accidents. These results make this treatment the one of choice in optic neuritis. **Oden** and **White** mention a case of neuroretinitis following salvarsan injection. In the survey of the situation there are cases reported of neuroretinitis appearing after the injection of arsphenamin.

Cohn has demonstrated that an idiosyncrasy for arsenic does exist, substantiated by a reported case in which retrobulbar neuritis developed following the administration of eight minims of Fowler's solution in twenty-four hours. In the case reported treatment with salvarsan was instituted one week after luetic development. He had four injections in four weeks. Following the fifth injection he showed blurred vision in the right eye; the disc was swollen four diopters, the retina was cloudy, the arteries were small, the veins were large and tortuous and there were floating vitreous opacities. The vision was 20/200. There was central scotoma for red and green.

Herdocia reports a case of double optic neuritis from syphilitic cerebral tumor, the patient being cured. The patient had ankylostoma and was given thymol. There was severe headache and nausea, slow pulse (thirty-four per minute), sudden loss of vision and inability to walk.

The pupils were dilated with slight light reaction. Only light perception was present. There was double optic neuritis, many retinal hemorrhages and the discs were congested. The retinal veins were engorged and tortuous; the veins were normal and covered with exudate. The discs were hazy in outline and surrounded by striated hemorrhages. The retina about the disc was similarly affected. There was temporal hemianopsia which corresponds to a lesion affecting the crossed fascicles of the chiasm. There were no ocular paralyses. The Wassermann reaction was strongly positive. The cerebrospinal fluid showed a marked lymphocytosis. She recovered under antiluetic treatment.

Sage advocates vigorous early treatment of syphilitic optic neuritis with arsenic, mercury inunctions and the administration of neosalvarsan before resorting to operative procedures.

TUBERCULOSIS.—**Hirsch** reports a case of giant tubercle of the optic papilla. The left eye was affected in a young man otherwise apparently healthy. The tubercle was formed in the head of the nerve. We must assume it was carried there by the blood stream and settled in the vascular network of the lamina cribrosa. As long as this was limited to the papilla, no disturbance of vision occurred. After granulation tissue passed over the papillary margin, slight visual disturbance occurred quite suddenly. In contrast with the retina, the tubercle appeared white. A cysticercus also gives the same appearance. The differentiation is uncertain; the cysticercus often has movement. There may be a rise in temperature; this should be taken often. Tuberculin injections will clear up such a case, and in this case tuberculin had caused a reduction of the mass. Two cases are quoted.

Oloff reporting two cases of tuberculosis of the optic nerve says in the first case the patient became suddenly blind without any apparent cause. Old tuberculin was subcutaneously injected with a strongly positive reaction. There was rapid improvement after the third injection. There was moderate atrophy of the optic nerve. This case had embolism of the central artery. The second case was one of thrombosis of the central vein. The pathologic findings of other cases suggest tuberculosis. In such cases where no other cause can be found tuberculosis should be suspected and the tuberculin test made.

Ishizu also observed a case of a man who died of miliary tuberculosis. On the papilla there was a tuberculous tumor, the retina was totally detached, the choroid infiltrated, and in the subretinal space there was an inflammatory exudate containing tubercle bacilli.

In a case of tuberculous meningitis **Ribon** reports that the discovery of papilledema with the ophthalmoscope helped to determine the diagnosis, which was confirmed by autopsy.

CHOKED DISC.—**Mills** in a lengthy discussion of papilledema says this has in great measure, and rightly so, displaced the older name optic neuritis. Tho due to many causes, it is mainly a part of general intracranial edema; or more precisely, it is one of the results of increased intracranial tension. Some of the anatomic facts are: (1) The skull in the adult is an unyielding box containing the brain and vessels. (2) There are no true lymphatics in the brain and spinal cord. (3) The brain is incompressable. Normally every systole of the heart leads to an increased pressure within the cranium.

When sinus thrombosis occurs, there is increased venous pressure in the cranium and hence edema occurs. The question, however, is not so simple as this; it does not take into consideration the cerebrospinal fluid. This fluid is the secretion of the choroid plexuses or gland, according to Mott. Glandular activity depends upon a proper blood supply. Increased amounts of cerebrospinal fluid within the cranium for any length of time must result in atrophy of brain tissue. The pressure from the cerebrospinal fluid cannot be greater than the arterial pressure, but it can be great enough to interfere with the venous circulation and so deprive the brain of its proper blood supply. The increased tension of the CO_2, which necessarily ensues, stimulates the vasomotor center and brings about an increase of the general blood supply. The growth of an hydatid cyst within the cranium liberates brain tissue as a result of atrophy; the increased pressure raises the tension of the CO_2; these two substances are the two most powerful stimulants of the secretion of the cerebrospinal fluid. Thus there will be increased intracranial tension.

There are three groups of substances which promote the flow and increase the pressure of the cerebrospinal fluid independently of those which affect it secondarily by altering the blood pressure. Group 1. Excess of CO_2 or lack of O and drugs which interfere with respiration. Group 2. The volatile anesthetics. Group 3. An extract of the choroid gland or of brain substance.

In destructive and rapidly growing tumors of the brain substance, this harmone is liberated and we have an excessive amount of cerebrospinal fluid secreted. It is in these cases we meet with the highest grade of papilledema. The same condition obtains in spinal cord tumor; i. e. a great increase of the cerebrospinal fluid due to the cause already outlined. Slow growing tumors, causing less destruction of brain substance, cause less secretion of cerebrospinal fluid. Four cases are reported, deductions from which seem to show that there are many substances of unknown origin which cause the choroid gland to secrete fluid in excessive amounts, and at a greater rate than the evacuant channels can dispose of in the same time. The fluid accumulates and the tension increases.

The tumors, infections and abscesses of the brain, lead, intestinal toxemias, meningitis, poliomyelitis, anemias and polioencephalitis cause this condition. The pressure of the fluid may be raised to such an extent that it would be forced into all the channels in connection with the subarachnoid space; such channels exist around the cranial nerves, and the optic nerves in particular. Here the dural sheath is continuous with the sclerotic, and the cerebrospinal fluid is thus within a cell or sac. If this fluid is under pressure, it must exercise this pressure on the structures contained within the sheath. This increased sheath pressure is also the origin of the second factor, the obstruction to the lymph drainage from the papillae. The cause of the increase in the intravenous pressure within the optic sheath is part of the general increase in the intracranial venous pressure brought about by the obstruction to the outflow from the cranium. This is brought about by the increased tension of the cerebrospinal fluid from the causes mentioned.

Those cases of papilledema, where there is no great increase of cerebrospinal fluid, must be due to the increased tension of a normal amount of the fluid in the dural sheath obstructing the socalled lymph space or cerebral veins or both. The *headaches* of the acute infections in their early stages are probably caused by a temporary increase of the fluid due to the increased secretion of the choroid gland.

The treatment of the papilledema is to remove the cause of the condition. While this is being attempted lumbar puncture lends great aid in the immediate amelioration of the symptoms. Lumbar puncture is contraindicated in cases of cerebellar tumor, as a number of fatal results have followed. In syphilis if the pressure and symptoms are not relieved in a few days, according to **Cushing**, a palliative decompression should be done.

A valuable criterion of the effect of the treatment and the need of early operation must rest with the condition of the eye grounds, which should be observed daily; for a choked disc may advance while the subjective symptoms are improved. Wilson suggests that relief of the papilledema might be had by exposing the optic nerve within the orbit in such a manner as is done for the extirpation of tumor and removal of a portion of the sheath. Such a procedure would allow the fluid to drain into the orbit; this might also relieve the intracranial tension.

In the discussion of optic neuritis, **Pockley**, while agreeing with Professor Mills that the term "optic neuritis" is not suitable for many of these cases, does not like the term "papilledema" for two reasons: The optic disc is not a papilla; and the term is a mongrel one, being a combination of a Latin and a Greek word. If a single word be desired, he suggests the word "kukloedema," a combination of two Greek words—the one meaning a disc, the other swelling. But what is wrong with the old term "choked disc"? It expresses the pathology of the condition, and has fewer syllables than either of the other single words referred to.

The operation of opening the optic nerve sheath requires a considerable amount of skill and is not devoid of risk. Either lumbar puncture or even craniotomy is a simpler operation. Undoubtedly intracranial pressure is a large factor, probably the chief factor in causing choked disc, but it is not the sole cause. In chronic hydrocephalus where the pressure is so great as to distend the skull, choked disc rarely occurs. Probably increased intracranial pressure, combined with some chemical changes in the cerebrospinal fluid induced by the growth, causes the choked discs. Failure to relieve the condition by a decompression operation may be regarded as negligence.

There are many points in reference to the connection between choked discs and cerebral growths which are puzzling and which cannot be explained by the pressure theory. Very small growths in certain parts of the brain induce intense swelling of the discs, whereas much larger rapidly growing tumors in other parts often fail to produce choked discs; or if they do, this occurs only late in the course of the disease.

A young married lady had a sarcoma of one frontal lobe, nearly as large as a goose egg (verified at postmortem examination), and until a few days before her death had no ocular indication of the presence of the growth and no other signs beyond moderate headache, and her attendant was not able to diagnose the trouble until the edema of the discs showed itself a few days before death. On the other hand, very small tumors in the cerebellum and other parts of the brain are generally accompanied by severe choked discs.

Lewis thinks the term "choked disc" should be reserved for cases of non-inflammatory edema of the nerve head, and should not be applied to true neuritis where there is an active inflammation. The subjective ocular symptoms of choked disc vary greatly, and may be due to meningitis, syphilis, nasal accessory sinus disease and brain tumor. The latter may exist for a long time without causing any other symptom save papillitis. He cites an interesting case substantiating his theories.

Cantonnet and **Saint Martin** report a case of unilateral papillary stasis from a foreign body in the orbit. There was an exophthalmos of the right eye from a shell wound of the orbit. Ophthalmoscopic examination showed a low grade choked disc on the internal inferior two-thirds of the disc. A foreign body was extracted, which was found to be a piece of shell. The contact with the nerve produced the stasis. There was also a purulent accumulation which produced the exophthalmos. The case was cured in a few weeks.

Brazeau discusses papillitis and glioma of the brain. He remarks that there are two kinds of inflammation of the disc; the one inflammatory in type, the other being papillitis by stasis. Gliomas of the brain substance probably lead in frequency and malignancy in brain tumors. A periodic loss of vision probably means a brain tumor. The cause of edema of the disc is most probably interference with the return circulation. This is explained by the intercommunicability of the space between the brain membranes and those of the optic nerve. The prognosis, where the papillitis is due to pressure, is dependent on the cause, as is also the amenability to treatment.

Schrader reports a case of double choked disc in cancer of the occipital bone. An injury resulted from a fall; following this, the patient developed a cancerous process in the occipital bone. The swelling developed a pulsation and bruit. The patient complained occasionally of dimness of vision. The examination of the eyes showed normal vision, color fields and blind spot. There was a choked disc of 2.5 D. The urine and general physical examinations were negative; Wassermann reaction negative; X-ray showed only the defect in the occipital bone. The tumor was removed. It was found to be a metastasis from a Grawitz tumor of the kidney. Deep X-ray treatment was given several times. The choked discs did not change but the vision became poorer. Severe headaches and dizziness were present. The patient died three years after the injury. The postmortem showed a cancer of the left kidney the size of a hen's egg. There was evidence of compression of the cerebellum. The left lobe of the thyroid also showed a cancer metastasis.

The examination of the globe of the eye showed moderate choked disc with cellular infiltration. The septa between the optic nerve fasiculi were thickened. There was pronounced thickening of the adventitia of the blood vessels. A portion of the optic nerve sheath was found to be infiltrated with small cells; this did not involve the optic nerve proper. This was apparently a cancerous metastasis of the sheath of the nerve.

Palich-Szanto reports swelling of the optic nerve resembling choroidal sarcoma and **Stargardt** drusen of the optic papilla.

Krauss discusses ophthalmic surgical experiences with injuries of the skull especially with affections of the optic disc. Observations on two hundred and eighteen cases of injuries of the head treated by operation give the following conclusions.

(1) Penetrating injuries of the skull must be under ophthalmologic control for at least two weeks, whether the eyes are complained of or not, whether slight or severe, operated or not, or wherever the injury is situated.

(2) Concurrence of papillitis two or three days after the injury in patients early operated upon always is an important symptom of a complication; as, increase of pressure, splintered bone, foreign bodies, development of meningitis, encephalitis, abscesses, etc.

(3) If the phenomena at the optic nerve occur in the later course or become aggravated, with or without general symptoms or local symptoms of defect, they are to be considered as a threatening sign and demand a radical revision of the wound by the surgeon. Every destructive injury of the skull by projectiles is to be regarded as infected and must be operated upon as soon as possible. The operation must aim at the removal of the primary, and prevention of the secondary infection from the wound. In a series of twenty-two cases there was not a single loss from infection.

Treatment of Choked Disc.—**Velez** advocates thecal puncture in the treatment of optic neuritis, having obtained good results in several cases of that nature treated by simple puncture; and now relates new cases, the puncture followed by injections of mercurialized horse serum.

Cushing in a short dissertation on *accessory sinus disease* and choked disc, says many unhappy consequences of indiscriminate and ill advised operations on these sinuses have come to the attention of the clinic at the Brigham Hospital. Suppurative inflammation of the ethmoid or sphenoid may, in certain cases, lead to inflammatory changes of the adjacent nerves; but it is inconceivable that these processes should produce choked disc. Choked disc is a condition brought about by mechanical causes, and optic neuritis, papillitis and other similar terms are misnomers for this condition. Inflammatory processes may affect the optic nerve in such a way as to produce reddening, injection and possibly such a degree of hyperemia and vascularity of the nerve head as to resemble the early hyperemic stage of a choked disc, but it is unbelievable that an infection of the accessory nasal sinuses in the absence of increased intracranial tension should produce an actual choked disc.

Quotation is made from an article on hyperplasia within the sinuses producing pressure sufficient to cause atrophy of the optic nerve. X-ray and and inspection showed no changes. It is stated that unless some definite explanation for the loss of vision can be found elsewhere, its most probable origin is the sinuses. The diagnosis of accessory sinus diseases in cases of practically negative nasal findings is largely made by exclusion. It would seem the wiser course here to err on the side of advising operation too soon and possibly unnecessarily, than to risk a patient becoming permanently blind thru delay.

Cushing cannot conceive of a feebler argument on which to base the widespread advocacy of so serious an operative procedure as one in the upper nasal region. These operations in the hands of the inexpert frequently mean disaster. He is often called in consultation by patients who are in extremis from meningitis following what was supposed to be a trifling intranasal operation. In these papers, like the above quoted, there is great confusion for the following reasons:

(1) In citations from literature there are many cases which antedate our knowledge of the mechanical factors producing optic atrophy and choked disc.

(2) In the variety of lesions considered, which vary from the obscure hyperplasia mentioned to actual suppurative processes or even sphenoidal tumors.

(3) In that these intranasal procedures of the ethmoid cells, removal of the middle turbinates or opening of the sphenoid cells, are supposed to relieve or forestall a great variety of processes variously described as retrobulbar neuritis, neuroretinitis, optic neuritis, papillitis and optic atrophy.

When a retrobulbar neuritis is said to be accompanied by two or three diopters of swelling, we are certainly dealing with something which a hyperplasia of the mucous membrane lining the accessory sinuses is not capable of producing. During the past year many patients with brain tumor have appeared in the Brigham Hospital clinic who had recently undergone radical intranasal operations for assumed infection of the sinuses. When these operations are performed on people with full blown changes in the optic nerves and with an idea that cleaning out the ethmoid and sphenoid regions might check the process, we have certainly gone too far.

Watkins agrees with Cushing that operation upon the ethmoidal and sphenoidal cells are too serious to be done hastily; that it is a very easy matter to expose and perforate the dura before the operator realizes what he has done. From a neurologic standpoint he thinks all cases should be carefully studied before operating.

Lecene and **Morax** discuss a case of adiposis genital syndrome with bilateral edema of the papillae in a boy of thirteen years. The boy suddenly became ill with vomiting and headaches; on the second day he saw double. The papillae were of a rose violet color and bulging. The veins were dilated and tortuous. The arteries were small and exudate on either side. Lumbar puncture showed slight pressure of the fluid. He was given pituitary extract and operation was performed, the nasal route being employed. Following the operation the papillary stasis disappeared. The hypophyseal space was not opened. The operation was what Cushing calls the sella decompression operation.

Belcher reports a case of oxycephaly with optic neuritis and choked disc in a child aged five.

Sloan reports a case with double choked disc, in which there was an operation and recovery. The patient, aged nineteen, suffered from headaches, failing vision and vomiting. V. R. cf. .2 in. L. no light perception. The pupils were dilated and fixed; discs showed nine diopters of swelling; the condition of the vessels was as usual under such conditions. There were many retinal hemorrhages. There was paresis of the right lateral rectus and paralysis of the left. The accessory sinuses, teeth, blood and spinal fluid were negative. The pressure of the last was twenty-six, the normal being about ten. The blood pressure was 128-80. There was ataxia of both hands. A temporal decompression was done with complete recovery of the patient. Dyschromatopsia is an earlier symptom of brain tumor than choked disc. The blue field may be interlaced or may be inverted with the red. There may be blue scotomata or total blue achromatopsia.

Muskens describes a case of gliosarcoma in the cerebellopontine region in a woman aged 27 relieved by Cushing's operation. Impending blindness was warded off; and the patient had two months of relief. Muskens points out that spontaneous remission with these tumors is not rare. He reports two others cases improved under X-ray treatment. The subsidence of the deafness, choked disc and the trigeminal neuralgia was gratifying. Time must tell if it be permanent.

Retrobulbar Neuritis.—**Schöppe** reports a case of retrobulbar neuritis during *lactation.* Three cases have been reported. They began with pain on moving the eyes. In his case, the right eye was painful to pressure and on moving the eyes, the pupil of the R. was slightly larger than that of the L. The light reaction was sluggish. There were no fundus changes and the urine and blood were normal. Metabolism showed an increased excretion of chlorides and nitrogen. The nasal accessory sinuses were normal. There was slight excitement of the vegetative nervous system, evidenced by demographia. While under observation, the pupillary reaction entirely disappeared, the discs became paler and borders less clear and the papillary tissue and neighboring retinal regions cloudy. Nursing was ordered stopped.

She had violent right hemicrania. The papillae became swollen one diopter, the veins dilated and the arteries contracted. Finally a striated hemorrhage occurred above and to the inner side of the disc. The symptoms slowly disappeared, and she was well on dismissal.

It is thought that lactation must be considered as a cause of retrobulbar neuritis; menstruation and the climacterism must also be considered as predisposing causes. It is not advisable to speak of a pure optic neuritis due to lactation only; other causes should be sought by a careful examination. In one case the following points had to be considered: history as related by the patient, frequent urination, falling of hair, tired feeling and hypersensitiveness of the vegetative system. After child birth, she had a fever of three days, probably influenza. This may have caused the neuritis. There were three months between the fever and the neuritis so that this probably was not a factor. The patient said that ten years before this she had an illness. This may have been beginning multiple sclerosis and the neuritis may have been a symptom which may have been precipitated by the lactation.

Marburg, writing of retrobulbar neuritis and *multiple sclerosis,* says the clinical symptoms differ little in these two conditions. The sudden appearance, the serious visual disturbance and the pain on pressure are found in both. The central scotoma is the simple oval form; rarely is there peripheral scotoma and most rarely amaurosis. The irregularity of the two fields of vision is most important. My view is that the course of the disease is important, the rapid appearance and disappearance. Frequently there is a temporal paleness of the disc with relatively good field of vision. The fluctuation of the process which is one of the characteristics of multiple sclerosis is also shown in this condition. One of the important points is that disturbance of vision never reaches a high degree in multiple sclerosis and blindness is a rarity. The accompanying symptoms of the associated diseases make the diagnosis possible.

Scheffler speaks of war experiences in the field of retrobulbar neuritis. Cases in the civil population group are more common with multiple sclerosis. It may be latent. There were two such cases in this group. There was no case of sinus disease in this group. In the military group multiple sclerosis also played the most important etiologic role.

In an article on retrobulbar neuritis **Strebel** calls attention to the importance for the prognosis of a change in the shape of the scotoma. This is particularly true of diabetes. Chronic axial neuritis shows an oval scotoma for red and green. In seven cases of the acute form, the scotoma was pericentric and star shaped.

The four point star usually results from inflammation from infection or toxins or both. The chronic oval form is the manifestation of dystrophia and degeneration, and this diabetic papillomacular neurodystrophia is of grave prognosis. A large proportion of cases recorded as amblyopia in diabetics are in fact cases of chronic neurodystrophia.

Strebel also writes of changes in the form of central scotomata in diabetic retrobulbar neuritis shortly before death, and asks on what clinical basis does the retrobulbar neuritis in diabetes arise?

The ketone and organic acids flood the blood and act on the papillomacular fibres particularly. This increase of acids is the essence of the autointoxication, the extreme degree of which represents the acid coma. In this condition these acids can be shown in the axial cord of the optic nerve.

Cross sections of fresh optic nerves should be stained and tested chemically. No such examinations have been made.

He also writes of chronic retrobulbar neuritis in chronic breast cancer. The intraocular optic nerves in this condition showed the white coat-of-arms picture of the retrobulbar type. There were horizontal central scotomata with normal peripheral fields. There was acetone in the urine. Retrobulbar neuritis in breast cancer is probably also an acid intoxication and might be treated by sodium carbonat. Chemical examination of the optic nerves might bring results of interest.

The changes in the form of the scotomata in retrobulbar neuritis has a prognostic importance as regards life and central vision. The ovoid form offers a good prognosis.

Woods writes of some considerations upon retrobulbar neuritis and summarizes as follows:

(1) Retrobulbar neuritis is essentially a diagnosis by exclusion.

(2) The scotomata. The position depends upon the nerve fibres involved; there is a shifting tendency.

(3) Search for constitutional cause. (a) Wassermann by blood and spinal fluid examinations. (b) Blood sugar coefficient. (c) Dental origin. (d) Sinuitis.

(4) Terminology.

The paper is a plea for broader consideration of the diagnosis of these ocular neuropathies and uniformity in the nomenclature employed. Special features are cited; as, the scotomata, etiology, and the importance of a correct and constant terminology.

Regarding the scotomata, any part of the nerve may be involved and so the scotomata may exist in any part of the field.

It may be negative or it may cause only a sense of blurred unsatisfactory vision. A case reported had what was at first thought to be glaucoma; blindness came on after iridectomy. No increase in tension was ever observed. The fellow eye remained about normal except for "a funny thing" in front of his eye. A scotoma was observed in the lower field. This scotoma always occurred with attacks of colonic impaction and intestinal stasis. The variation in position and extent of the scotoma is peculiar; also persistent asthenopia is a suggestive symptom of retrobulbar neuritis. The scotoma tends to recover spontaneously. It is nearly always more marked for red. Blindness for red persists after that for white and blue have cleared. This fixes the lesion in the nerve.

When the toxic effect is principally on the retinal cells blue scotomata predominate. These scotomata will only be found on careful search. In searching for the cause great care is necessary. The blood should be searched for evidence of syphilis and the sugar coefficient studied. Dental and sinus infection are eliminated.

Ronne discussing the classification of retrobulbar neuritis says there are several classes of cases which differ etiologically and clinically. It is difficult to divide those differing etiologically as they often have a double etiology. He discusses mostly chronic retrobulbar neuritis. This condition has three etiologic factors principally: 1. Alcohol and tobacco amblyopia. 2. Diabetes. 3. Leber's hereditary neuritis.

These three conditions are distinguished by: A. Constant bilaterality. B. Predominance in men.

Between the alcohol, tobacco and Leber's groups is a group which is usually diagnosed as atrophy of the optic nerve and not retrobulbar neuritis, as it is usually seen late.

RETROBULBAR NEURITIS AND SINUS DISEASE.—**Bordley** in a full discussion of optic nerve disturbances in diseases of the posterior nasal sinuses observes that one of the most far reaching discoveries to ophthalmology was that of the blind spot by Mariotte. It ultimately resulted in the location within the body of the optic nerve the peripapillar and the papillomacular bundles. There was much discussion as to the reason for the blind spot. Donders demonstrated that it corresponded to the entrance into the globe of the optic nerve. It became necessary that the course of the fibers that supply the retina immediately around the disc should be traced. Fuchs demonstrated that these fibers are the most peripheral in the optic nerve and that they were in the most vascular portion. Samuelson demonstrated in two eyes with central scotoma, the result of toxic amblyopia, the relation of these fibres in the nerves. In the vascular portion of the nerve the papillomacular portion is V-shaped. In the avascular portion the bundle becomes round and recedes from the periphery. In the intracanalicular part it becomes crescentric lying immediately in contact with the vein of Vossius.

The lateral and inferior walls of the orbit in the neighborhood of the accessory sinuses are thin and covered with periosteum closely attached and often penetrated with diploic veins arising in the sinus walls and emptying into the orbital veins. The periosteal covering of the orbit in the optic canal is indistinguishably blended with the dural sheath. The walls of the optic canal frequently separate the nerve either from the sphenoidal sinus or the most posterior ethmoid cells, or both.

The orbit mainly derives its blood supply from the ophthalmic artery and its veins empty into the ophthalmic vein. The vascular portion of the nerve is supplied and drained by the central vessels of the retina, the avascular portion by the small recurrent branches from the central vessels. These are known as the posterior central artery and vein. The foramenal portion is supplied by the small ophthalmic artery and is drained by the vein of Vossius, emptying into the cavernous sinus.

The portion of the nerve mostly involved in sinus disease is that within the optic foramen. Some think edema in the canal with consequent venous stasis is the cause, while others think mechanical pressure as evinced by enlargement of the blind spot, while still others that the cause is direct transmission of the toxins from the sinuses into and around the vein of Vossius and the capillaries that supply the central bundle. Enlargement of the blind spot is a frequent symptom of acute sinuitis more often than of the chronic form. This symptom is found in acute nasal infection with involvement of the sinuses.

The central scotomas are the most important symptoms. The papillomacular bundle is the most vulnerable portion of the nerve. In the optic canal it lies in close proximity to the vein of Vossius which receives its branches from the periosteum of the orbit and sinuses. It has the greatest capillary circulation of any part of the nerve. The optic canal is of rigid structure and allows little expansion of the soft structures within its confines. Contraction of the fields of vision is of doubtful value. This occurs in acute diseases very frequently.

The ophthalmoscopic pictures varied from a normal head to profound choked disc. This picture is only of suggestive value.

Loeb reports two interesting cases of blindness of nasal origin relieved by exenteration of the ethmoid. The first case was bilateral and was completely relieved by operation. The second case was unilateral and vision improved following application of cocain during ten days' observation. There was complete restoration of vision after operation.

Meller in a paper on the relation of retrobulbar neuritis to nasal accessory sinus disease with reference to the etiology and therapeutics says that rhinogenous neuritis shows no well defined picture; it is usually on one side and may begin slowly, while at other times it may be severe and with rapid disturbance of the vision.

There is usually a history of a severe cold preceding the condition. There may have been pain on movement of the eyes or on pressure of the globe. There is frontal headache and sensitiveness of supraorbital or infraorbital nerve. The enlargement of the blind spot is the most important and earliest symptom of rhinologic neuritis.

Crane reports three cases of posterior sinus infection with optic nerve involvement. In the first case the patient was seen during the acute stage of the optic nerve involvement. Prompt operative treatment gave immediate relief; vision returning on the third day. This was followed by apparently no change, which again was followed by a period of gradual improvement in the nerve and a complete recovery.

Case 2 was operated on early followed by a subsidence of optic neuritis and complete restoration of vision. Case 3 presented an entirely different picture. The acute sinus attack and the acute optic neuritis had occurred possibly two years previous to the date of the first examination. Total blindness of the right eye was noticed 6 months previously. The examination disclosed no active sinus infection, but the left optic nerve showed signs of a progressive neuritis. Operative procedure was considered the only chance of saving the left eye; and was followed by gradual subsidence of all activity in the left nerve. It seems fair to assume that cases 1 and 2 could have had as satisfactory result if the patient had been seen sufficiently early.

Hajek gives a critical review of the rhinogenous origin of retrobulbar neuritis with regard especially to those cases of retrobulbar neuritis in which there are no outspoken pathologic changes of the posterior nasal accessory sinuses. In these cases the rhinologic origin is doubtful. Two questions have been brought up.

1. The proof of the rhinologic origin of retrobulbar neuritis with negative or insufficient nasal findings but with favorable results after endonasal operation. 2. Is the indication for endonasal operation to be decided by the rhinologist? A prolonged discussion of these two questions is entered upon.

Retrobulbar neuritis arising from disease of the nasal sinuses was discussed by **Purtscher** who found the cases of such neuritis constituted about 8% of the patients examined. A large proportion of them, however, were ascribed to tobacco. In discussion Neumann pointed out that varied lesions of the nose might be associated with disease of the optic nerve, and that in still other cases no evident lesion was present. Kestenbaum, among 35 cases of retrobulbar neuritis, found 8 had been subjected to nasal operations, and all showed some improvement. Of the 27 not operated on 18 were cured, V=6/12 or over; 6 were improved (V=6/60) and in 2 it remained below 6/60, probably from complications. The general tone of the discussion was skeptical and it was agreed that extensive statistics would be required to prove that the conditions had any essential connection. Writing on latent inflammation of the nasal sinuses and neuritis **Heusen** and **Haren** conclude that if looked for sinus disease may be more frequently found in connection with disease of the ethmoidal cells, especially the posterior cells. They urge conservative treatment, phototherapy and applications to the mucous membrane.

Brückner writes extensively on disease of the optic nerve connected with nasal sinus disease (see also p. 402).

Herzog in the discussion of the etiology of rhinogenic optic neuritis says the diagnosis of this condition is by exclusion.

The connection of the latter is easy to see where there are distinct lesions in the nose or the sinuses; but in the two cases cited by the author, the lesions present would not appear sufficient to cause the neuritis. Following the operation, however, there was a prompt subsidence of the neuritis, with improvement of vision. There was present in both cases a distinct affection of the bony wall of the sinus, and the author thinks that some such factor must be present in that small percentage of acute or chronic inflammations of the nose which give rise to neuritis.

A case of retrobulbar neuritis in a woman aged 43 years is reported by **Bane.** A submucous resection of the septum was done and the sphenoids were drained, and steady improvement in vision followed. Later both middle turbinates were amputated and the left posterior ethmoids were exenterated. Vision is R. 3/60 plus; L. 5/4 — 3.

Gonzalez Sanchez points out some cases of blindness following sphenoidal sinuitis observed by him and gives the warning to medical men and oculists in order that in cases of blindness difficult to investigate the cause, they may not overlook the examination of the bony sinuses of the face. **Cheval** reports blindness caused by compression of optic nerve from sinus disease.

Strickler reports a case of retrobulbar neuritis from multiple focal infection. The left maxillary sinus was found full of pus, and after opening the antrum the vision rose to 20/200, but the fundus appearance remained unchanged. **Dinser** and **Glas** write on retrobubuar neuritis, and **Goris** reports exophthalmos of the right eye and optic neuritis caused by ethmoiditis.

Myers, in a short treatise on blindness as a symptom of obscure ethmoid disease, says that it is most important that early operation should be resorted to, otherwise the nerve may atrophy. Few cases are reported as recovering that have gone far enough to produce choking of the disc. He reports two cases in which there were very obscure symptoms of accessory sinus involvement but in which operation gave prompt relief and subsequent cure. The important feature of these cases is that early operation was resorted to which prevented permanent damage to the optic nerve and retina.

RETROBULBAR NEURITIS AND DENTAL DISEASE.—**Zaniboni** discusses optic neuritis of dental origin. In ninety-five per cent of the cases of retrobulbar neuritis root periostitis of the premolars was the cause. The medium of infection is the blood vessels, the periosteum, the cellular tissue and perhaps the nerves. The blood vessels play the most important part, particularly the veins. From the molars there extend bony channels thru the upper jaw to the sinus lacrimalis and to the lower orbital margin. The pathologic material may pass thru the venae vorticosae and posterior ciliary veins to the choroid and thru the central veins of the retina to the optic nerve. The teeth of the lower jaw can also cause inflammation in the eye. The transmission is also metastatic via a thrombophlebitis.

Smith reports a case of retrobulbar neuritis due to dental sepsis. The patient complained only of a haze over the right eye. There was a small horizontal, oval, paracentral scotoma for red and green extending from and including the fixation point nasally ten degrees. This was striking, as the papillomacular bundle has a similar distribution but on the opposite side of the fixation point. The curious affinity of certain nerves and even of certain bundles of nerve fibrils for certain poisons may probably be explained by minute differences of molecular chemical constitution. Examples of this are the affinity of the musculospirals for lead, the anterior crurals for alcohol, etc.

The condition described pointed to an early affection of the optic nerve and probably to a toxemia. It would probably have followed Gowers' postulate and become symmetric if given time. This case, however, was only four days old. There was a dead front tooth. This was drilled and sterilized and complete recovery obtained.

OPTIC NERVE ATROPHY.—**Benedict** in a paper on pituitary tumor with ocular phenomena says the advance in surgical therapy is due to more certainty of earlier diagnosis in this condition than formerly. Ocular changes constitute the chief symptom in a large number of cases. These consist in contracted fields, lowered visual acuity and changes in the appearance of the nerve heads.

Patients who complain of headache, lowered visual acuity not improved by glasses and inability to concentrate on mental work, should be examined in detail. These cases often present no constitutional symptoms or demonstrable changes in the central nervous system other than the ocular apparatus. The changes in visual acuity are very slow and gradual at times. The most characteristic field is bitemporal hemianopsia or homonymous hemianopsia. Rapid changes in the fields may occur. One quadrant of the field only may be affected, the fellow eye being unaffected or blind.

Any manipulation or operations about the nose, which temporarily increase the circulation about the nasopharynx, may temporarily increase the fields. Field examinations requiring more than half an hour are apt to be unreliable on account of the fatigue of the patient.

A peculiar waxy pallor of the disc is

practically a diagnostic feature. This pallor is not due to atrophy of the nerve unless vision has been destroyed for a long time, in which case there is atrophic excavation of the nerve. The pallor of the disc without loss of substance is the characteristic ophthalmoscopic feature of the chiasmic pressure. There are no other changes in the disc or the large vessels. There is obliteration of the large vessels. The pallor is widely distributed over the disc. It appears about the fourth month in a larger number of cases. The longer the duration of visual disturbance before the advent of the pallor, the slower the growth of the tumor. Rapid atrophy of the disc means rapidly increasing growth of the tumor and hence suggests malignancy. Optic atrophy, occurring after long duration of visual symptoms, cannot be helped by operation. The amount of shrinkage of the disc will alone tell us what the prognosis for vision may be. The visual fields and acuity will not give us this information. The Röntgenologic examination of the head may show changes in configuration of the sella. Enlargement and destruction of certain of the parts may result from other intracranial disorders. No changes may be demonstrable. Ocular phenomena from pituitary tumor often develop early in the course of the disease. The decision on operation should rest on changes in the field and appearance of the discs.

Timme, writing on the pituitary findings in the mongolian idiot, notes a peculiar change in the anterior portion of the pituitary fossa. This consists of an excavation under the anterior clinoid processes and presumably under the olivary processes and optic groove. The excavation communicated directly with the anterior portion of the fossa itself.

Such an excavation, involving at times the optic groove, should make eye symptoms of frequent occurrence. A complete resumé of such symptoms has been published by Oliver. Among these findings may be mentioned the following:

The optic discs in a number of cases are unequally grayed, especially in the deeper layers and to the temporal sides; the substance of the disc in a great majority of the cases, especially where the retinal and choroidal disturbance was not pronounced, is apparently edematous; the retina surrounding the optic nerve is edematous and swollen in many of the cases.

Harman reports the case of a girl aged 11 in whom a defect of the right eye had been found in examination at school. The right vision was less than 6/60, the left 6/6. Retinoscopy R. and L. —1. D. Right disc primary optic atrophy, no choroiditis. Colors could be seen in the temporal field, but not in the nasal. There was unilateral leontiasis ossia. The movements of the eyes were normal and there was no exophthalmos. The Wassermann was negative. Harman thought the ocular complication of optic atrophy was due to the optical bone sharing in the enlargement. The bone was very dense in character.

Goerlitz reports the histologic examination of the optic nerve in a case of blindness following hemorrhage. The cause of death was hemorrhage from duodenal ulcer. The papillae were swollen and the central vascular funnel was not present. The nerve fibers seemed to be forced apart. The central vessels were much dilated. There was no change in the vessel walls. In the fibrous layer of the retina there were peculiar nodules which projected into the interior of the eye. These nodules consisted of an accumulation of spheroovoid structures in the fibrous layer, forcing them apart. Stronger magnification showed these nodules to be delimited by a membrane. They had a well defined nucleus.

There were well defined degenerative foci immediately behind the lamina cribrosa in the trunk of the nerve. There were round, sharply defined degenerative foci in the medullary nerve sheaths. These foci were mostly in the periphery of the optic nerve. They resembled the degenerative foci in multiple sclerosis, when stained by the method of Weigert.

Camerer reports two cases of optic atrophy to set forth how an apparently insignificant injury to the orbit region can cause such disastrous effects to the eye. In each case the injury was to the left eye entering the orbital fossa for a short distance. The eyes were treated and bandaged; when removed vision in each case diminished and ophthalmoscopically choked disc and optic atrophy were discovered, causing in the one case total blindness and in the other vision reduced to Snellen type for 200 feet when approached within one foot of it. The etiology is supposed to be a blood clot at or near the optic foramen causing pressure on the optic nerve. Both patients were in good physical condition when injured.

Wiegman reports two cases of injury of the optic nerve with unusual course after head injury. The injury of the head was by a blunt instrument. Bilateral injury to the optic nerves in head injury presupposes a serious head lesion dangerous to life. A lesser injury, however, to the bones of the face may cause this condition.

The injury, which was a fall on the left side of the head, caused a lesion which could not be located. Serious fracture was excluded. An injury which would affect both optic nerves would have to be a serious fracture. There seems only one assumption, that the seat of the injury was in the bony optic canal. There was no disturbance of the visual function for the first twenty-four hours except by obscurations of the vision now and then. The day following the injury there was bilateral blindness. The injury, therefore, did not destroy the nerve fibers at once, but a degeneration occurred.

Crushed optic nerve fibers may recover completely. If it had been a hemorrhage, it must of necessity have been in the nerve sheath. The best interpretation would be that a bilateral contusion of the nerves took place with degeneration following.

The second case was a gunshot wound. The visual disturbance occurred one and one-half years later. So that we must assume an influence, a later disturbing influence, of the bullet track on the optic apparatus; a fresh hemorrhage, cicatricial contraction or callous formation.

Igersheimer makes a clinical contribution to the pathology of the optic nerve, in which he says glaucomatous atrophy is marked by diminution of the light sense more than all other forms of atrophy. Differences in dark adaptation may be an early symptom in glaucoma before the other symptoms make their appearance. It may exist with normal fundus fields and vision and it may be the only morbid symptom.

We must assume that definite groups of fibers suffer first. In retrobulbar neuritis it is well known that central and paracentral scotomata exist with normal ophthalmoscopic findings. There is pain on pressure and movement of the eyes in this condition. The large central scotoma which goes to the periphery of the visual field in some cases is characteristic; the blindness and other defects of the field of vision are based only on temporary interruptions of the uninflamed nerve fibers of the optic tract. Therefore the central scotoma disappears last if at all.

In nasal sinus disease it is not settled how interference with the optic nerve takes place. Circulatory disturbances thru pressure and toxic factors are mentioned as causes.

Fuchs divides the premonitory symptoms of ocular disorders with *tabes* into (1) pupillary signs; (2) paralysis of the oculomotor; (3) atrophy of the optic nerve. The latter he considers the most frequent complication ending unavoidably in blindness. Atrophy attacks 10 to 15 per cent of all tabes patients; chiefly men in the prime of life. Infantile tabes is very rare, but is accompanied almost always by atrophy of the optic nerve. The atrophy does not occur at the same time in the two eyes, but very seldom is a case found in which the atrophy remains unilateral. The optic disc is often found pale at a time when the patient is not yet complaining about his eyes. This pallor of the disc shows that the degeneration occurs in the anterior ending of the optic nerve in the peripheral bundles. The first symptom is the retarded adaptation to darkness with diminished acuteness for colors while the form field remains. Complete blindness results in from two months to twenty or more years. The introduction of remedies directly into the cerebrospinal fluid has met with success in other symptoms of tabes and lends hope that this method may prove effective in atrophy of the optic nerve.

Parker in a paper on juvenile tabes summarizes seven cases. In all of these Westphal's sign was present; in six some diminution of sensibility; in four the pupils were immobile; in three there were Argyll Robertson pupils, optic atrophy, crises, lightning pains, incoordination and hypotonia. In one there was ataxia. There was a positive serum Wassermann in six cases, as was the spinal fluid in three. Characteristic of the cases was the insidious onset and lengthy or latent course, during which no subjective complaint was made. The frequency of incontinence of urine, the relative rarity of ataxia, girdle sensations and lightning pains and the frequent paretic termination distinguish juvenile from adult tabes.

Leichtmann reports a case of multiple sclerosis with a long period of remission. Cases which begin with optic atrophy usually show these long intervals. One case began with visual and ataxic disturbances and scanning speech. It lasted six months followed by apparently complete cure.

The patient was well ten years and then the symptoms of multiple sclerosis reappeared. Several such cases are reported.

Ginestous reports atrophy of optic nerve in hereditary syphilis.

Junius, discussing the question of the etiologically obscure cases of atrophy of the optic nerve, particularly in soldiers who served in the World War, says multiple sclerosis and accessory sinus disease are responsible for many such cases. These patients may be divided into three classes:

(1) Those with normal eyes at the beginning who developed progressive diminution of the visual acuity.

(2) Those in which the atrophy was preceded by injury of the eye but in which the injury was not thought to be responsible for the atrophy.

(3) Those who were drafted for the military service by mistake, having high grade atrophy of the optic nerve. This last group is not discussed. A number of cases are reported under groups one and two.

The conclusions as to group one are as follows: No excesses of alcohol or tobacco were observed. There was found no involvement of the nasal accessory sinuses, or syphilis. There were five cases in group one; in three cases no cause could be found; one had malaria with consequent anemia; one had nephritis and chronic intestinal trouble.

In group two many of the injuries do not appear material. The following facts from history obtained from the patients are of importance: malarial poisoning, gassing, exposure to cold and wet, and exposure to influence of dinitrobenzol, methyl alcohol; injuries of special character; hereditary causes.

Malaria as a cause can be dismissed; as for gas, it only causes inflammation of the lids and this cause may also be discarded. All kinds of eye trouble are laid to gassing, hypermetropia, myopia, astigmatism, etc. Many cases of atrophy occur from unknown causes; final judgment can only be made after thoro sifting of all cases.

A certain class of cases ran a course like acute retrobulbar neuritis. The vision decreased in the course of a few days or weeks, but not as rapidly as acute retrobulbar neuritis. It is mostly bilateral and the eyes are usually affected at the same time, or it may be one after the other. Central scotoma and also involvement of the peripheral field of vision may occur. These cases therefore do not exactly correspond to acute retrobulbar neuritis. Facts seem to show that cold, exposure and privation have a certain effect upon the optic nerve, acting perhaps like mild infectious diseases which lower the resistance of the body; then bacteria or poisons in the blood attack the structure of the optic nerve. The sensitive papillomacular bundle suffers most. Heredity may play a part.

Mercury treatment produced improvement in this last class of cases; eight such cases are found in the literature. The optic nerve is usually injured on account of the anatomic condition. The atrophy may be caused from inflammation, high cerebral pressure or direct pressure, mostly the latter. The pathologic anatomy has not shown much. Not finding inflammatory changes does not negative them.

Van der Hoeve, speaking of mucocele of the sphenoid and ethmoid sinuses with atrophy of the optic nerve, says that these sinuses are nearly always greatly affected. It is necessary that this condition be early diagnosed before serious damage has occurred to the optic nerve.

In a case reported the wall and roof of the sinuses were destroyed so that a probe reached the dura. Cerebrospinal fluid drained off. X-ray did not reveal any change. The optic nerves were pressed upon, however. The changes in the fields of vision were interesting. At one time there was a central scotoma for colors; at other times there was no central scotoma but high grade constriction of the peripheral field, depending probably on the portion of the optic nerve more pressed upon.

Acuity of vision and paresis of the eye muscles varied greatly at different times, also due to difference in pressure. Only nine such cases are quoted in the literature. Review of these cases shows a constant condition in all enlargement more or less of the sphenoidal sinus.

Hajek gives a definition of mucocele. A collection in a sinus of a fluid which is not pus. If the sinus is completely closed, increased pressure results. In uncomplicated cases of mucocele there is a thinning of the walls of the sinus so that in places only a membrane remains. This condition is thought to begin early in life before the walls of the sinus are completely ossified. In five cases the sphenoid sinus was enlarged; in three cases also the ethmoid. In some cases it was bilateral. In these cases the optic nerve is usually seriously injured, due to the pressure.

The atrophy may be due to optic neuritis, to cerebral pressure with choked disc or by direct pressure; most often the last. This is proved by the rapid improvement before atrophy has supervened, on puncture of the sinus. The changes in the visual fields were not constant. In one case there was peripheral limitation of the colors; under changing conditions of pressure this condition may rapidly change; central scotoma for colors; peripheral limitation for colors and finally slight limitation of the periphery for motion and colors. Of nine cases quoted, seven became blind, and in two there was serious menace to the vision.

The high pressure explains all the different symptoms; as headache, paralysis of the muscles, atrophy of the optic nerve or choked disc; on variance of the pressure any, or all of these symptoms may change. Immediately after puncture the visual acuity may rapidly increase. The diagnosis is very difficult and it is often mistaken for brain tumor.

Benjamins' discussion of Van der Hoeve's paper is interesting. He found numerous mucous glands which may cause increased secretion. He also found marked thickening of the mucous membrane and of the intima of the arteries. The capillaries were congested. Most cases showed cholesteremia in large quantities.

The origin of mucocele is: cystic degeneration of the mucous membrane, closure of the ostium, growth of ethmoid cysts, which grow into other accessory sinuses and dilate them.

The closure of the ostium is the most frequent cause. Inflammation is not a necessary condition, as mucocele may arise from normal membrane. Benjamins has shown how a mucocele may occur from hypersecretion from an abnormally large number of mucous glands. When infection is present in the closed cavity an empyema may arise. The germs may be destroyed by their metabolic products and a mucocele reproduced. Hemorrhage may occur, hematocele. Pressure explains all the symptoms; atrophy, choked disc, paralysis of eye muscles, etc. Relief of pressure results in the relief of symptoms. Absorption of toxins may add to the pressure effect. Pressure results in closure of the blood vessels, and thus rarification of the bones occurs.

Santos Fernandez reports a case of atrophy of the optic nerve following cataract extraction. Two months after the operation the eye was amaurotic. The operation was without incident.

The ophthalmoscope showed a complete atrophy of the disc without cupping. The patient had suffered from fifth nerve neuralgia which had been treated with perhaps too much quinin. There was no other cause for the atrophy than the operation. Golesceano has reported cases of atrophy of the nerve following cataract extraction some time after the operation.

Treatment of Optic Atrophy.—**Abadie** reports on pericarotid sympathectomy in certain cases of optic atrophy. The atrophy was thought to be attributable to a permanent constriction of the arteries which supplied the optic nerve. They can be differentiated from those which have a different origin, the characteristics being as follows:

(1) The functional visual disturbance shows itself by a characteristic contraction of the field of vision. It occurs first on the nasal side, as in glaucoma, and especially below; the central vision is maintained and is relatively good for a long time. The internal and inferior field disappears long before the outer and superior. Finally the latter contracts, the upper portion is lost and blindness is complete. Another important functional disturbance is that the vision undergoes great variations without apparent cause. This is usually noted by the patient.

The pupils, tho not contracted as in tabes, are, however, more narrow than normally and there is no light reflex. The eye, having the greatest atrophy, shows the greatest contraction of the pupil. The pupil does not open normally to mydriatics. Atropin produced only a moderate dilatation. With the ophthalmoscope the papillae were white and sharply outlined, the arteries shrunken and this more so in the advanced stage. The caliber of the veins was well preserved. The author concludes that in these cases there is a permanent spasm of the arteries nourishing the optic nerve.

The visual field contraction is peculiar and is in direct relation to the arterial supply of the retina, being less in the temporal than in the nasal region; hence the functional disturbances. The small artery which supplies the inferior portion is more important than that supplying the superior; hence the upper part of the field is first affected. The variations in the vision are thus accounted for; the arterial spasm, tho being permanent undergoes fluctuations. The contraction of the pupil is no doubt due to a spasm of the constrictor fibres of the iris.

What happens with large doses of quinin? An excessive acute constriction of the retinal vessels producing all the clinical signs enumerated. This proves that under certain influences there may be a vasomotor constriction of the arteries, greatly influencing the nutrition, which ends in a special form of atrophy of the optic nerve. By preventing the vasoconstriction he has tried to cure this condition. He has tried sectioning the sympathetic nerves which surround the internal carotid artery at its origin. These are the beginning of the carotid plexus which regulates the circulation of the optic nerve and retina. This operation was done in de Lapersonne's clinic in the case of a man who had severe lancinating pains in his lower extremities indicating tabes. There were no motor symptoms or incoordination. In fifteen years the vision of the left eye was lost; during the course of one year when he saw him, the right eye was also affected and presented all the conditions due to constriction of the retinal vessels. The nasal and lower fields were contracted temporarily, the retinal arteries very narrow and the pupils slightly contracted.

Pericarotid sympathectomy was done on the right side. The common carotid was uncovered at the level of the bifurcation. The cellular tissues surrounding the artery and the sympathetic filaments contained in it were removed. The patient said he could see better the next day. The visual field began to expand a little on the nasal side, and this rapidly increased; the visual acuity improved slowly.

For a month the condition remained stationary. The results were brilliant and confirmed his ideas of this condition, but sad to relate two months after the operation the vision began rapidly to fail and the fields to contract.

All the filaments the carotid might have from the superior cervical ganglion were removed upwards on the internal carotid. There had formed dense cicatricial tissue about the common carotid. He was compelled to ligate the common carotid. Strangely enough, an improvement took place in the eye; this, however, declined as before and ended in blindness.

Baumgartner operated one of Abadie's patients in an advanced stage but only a slight improvement was noted. In two other cases operated in an advanced stage, the results were the same.

Gunther, discussing the treatment of optic nerve atrophy in locomotor ataxia, says: as this represents a late symptom of locomotor ataxia and as salvarsan has been found bad for the optic nerve, we can use only mercury as an antisyphilitic. A case in point is quoted. Hirschberg, Greeff and others mention like cases.

Suker reports the case of a young man with optic atrophy, bilateral in whom 20/20 vision had been maintained for four years by the intraventricular injection of bichlorid of mercury into the anterior horn of the right lateral ventricle. In all he received six injections varying from 1/100 gram to 1/25. The mercury was added to about ½ of the intraventricular fluid withdrawn and reinjected into the ventricle. Systemic and antisyphilitic treatment was also given.

Lacah reports atrophy of the optic nerve secondary to chorioretinitis much relieved by injections of cyanid continued over a long period.

Siegrist presented at the meeting of Swiss oculists a boy who at four and one-half years had enormous papilledema and bilateral abducens paresis, with frequent epileptiform seizures and vision reduced to light perception. Wassermann and tuberculin tests were negative. Tumor of the base of the brain was diagnosed, and lumbar punctures tried. Tension of the spinal fluid was at first 550 mm. After four punctures the seizures diminished and function of the abducens and facial nerves improved. Thirty-two punctures were practiced in about two years and the spinal tension became normal. At the age of nine years vision had risen to 1/10 which enabled the boy to go about and do work not requiring acute vision. Siegrist called attention to the value of this treatment in papilledema before resorting to trephining. Sometimes a single lumbar puncture was sufficient.

HEREDITARY OPTIC ATROPHY.—A family affected with socalled Leber's disease is reported by **Du Seutre.** A man of 37 had begun to lose his sight at the age of 21 and it was now reduced to light perception, so that he could not go about alone. A brother aged 24 had been first affected at 17. He still possessed vision enough to go about and in spite of a central scotoma extending to about 20 degrees absolute in one eye and almost absolute in the other. Another brother aged 39 had begun to lose his vision at 33, but still retained enough to read large letters. A sister aged 33 was in good health with three healthy children. Another sister aged 31 had loss of sight for some months when it became stationary. She could go about with difficulty but could not read. The mother of these patients had vision impaired at the age of 28 so that she could not read but could still do her work. Her brother became completely blind at 46. A sister had impaired vision from the age of 30, three other sisters had good vision to the ages of 60 to 70, and one other had sight impaired at about 35.

Griscom, in a brief paper on hereditary optic atrophy, reports the pedigree chart (physical) and X-ray findings in three generations of thirty-three individuals.

In the first generation the father had poor vision and the mother good vision; thus the affection was transmitted to the second generation thru an unaffected female, the usual procedure in Leber's disease. The patients were well nourished, intelligent individuals without evident hereditary deficiencies except poor vision, which in each case began in early childhood. There was no consanguinity. A detailed report of the field findings is made. The physical and laboratory findings were normal. The sella turcica and sphenoids were normal in all but one case in which the sella was slightly beyond the normal limit.

The visual fields, as reported by a number of observers, are fairly constant, the leading feature, as reported by Nettleship, being a central or paracentral scotoma with preservation of the form fields. An interesting suggestion that the pituitary gland might be responsible for the optic atrophy was made by Fisher as a result of his X-ray findings. As there was no record in the report that his patients showed any evidence of hyperpituitarism and the visual fields gave no evidence that any portion of the optic tracts had been encroached upon by an enlarged pituitary body, it is difficult to explain the constant preservation of the form fields. In the absence of any other general or local activity of the gland, one cannot be greatly impressed with its importance as a causative factor in hereditary optic atrophy. In the cases reported above; aside from the white optic nerve atrophy, the most constant fundus picture was the evidence of a low grade retinal degeneration as shown by the slight pigment disturbance and the atrophic vessels. The fields conformed to the preservation of form, but the scotomata were all paracentral or annular instead of the visual central scotoma. The analogy between Leber's disease in its early stages and certain toxic amblyopias has been pointed out by Cargill.

A study of the eye grounds in conjunction with the visual fields leads to the conclusion that the family herein described had suffered from a low grade early toxemia which attacked the optic nerve and retina in particular, with consequent nutritional disturbances. Probably some type of perverted secretion acting on unstable nerve elements was the underlying cause.

Inouye observed a case of hereditary optic atrophy in a family in which a number of individuals had suffered from the affection. Two cases in this family were examined. A central scotoma associated with a peripheral defect was found. The X-ray showed enlarged posterior clinoids and slight shallowing of the cella. The affection is probably caused by the changes in the sella which may cause the hypophysis to produce pressure on the chiasm. The papillomacular bundles, being the least resistant fibers, are first involved.

SECONDARY DEGENERATION OF THE OPTIC NERVE.—**Gelhorn** makes the following observations on the changes in the optic nerve following intraocular inflammation resulting in destruction of the globe.

In all twenty cases were examined. Of these twelve showed perforation of the cornea and one a contusion without perforating injury. There were eight in which perforation of the sclera occurred. Phthisis bulbi was observed nine times.

The pathologic changes of the optic nerve are divided into: 1. Degeneration without inflammation, 2. Changes of an inflammatory-degenerative nature.

(1) The least important change was the degeneration of the medullary sheath. There was thickening of the nerve fibers and increase in the nuclei of the glia and connective tissue. There was absorption and disappearance of the degenerated medullary tis-

sue and in its place the proliferated glia and connective tissue appeared. In these cases we find only atrophy of the optic nerve, particularly the middle portion.

(2) Inflammatory changes occurred in the nerve, particularly in those cases where inflammation had occurred in the posterior part of the globe. He observed that the connective tissue septa of the optic nerve were infiltrated with round cells; and the glia and connective tissues were rich in nuclei. Some cases show degeneration of the nerve fibres and the medullated substance. The degenerative changes occurring in the nerve fibers and marrow sheaths bear no relation to the intensity of the inflammatory disturbance. The cause of the degenerative changes in the nerve stem is not due to the extension of the inflammatory processes. The toxins produced as a result of this inflammation cause these changes. In some cases severe intraocular hemorrhages, by their pressure, have by mechanical means an important bearing on this condition.

After the inflammatory process has run its course and the degenerated medullary sheaths and nerve fibers have become absorbed, an atrophy of the optic nerve makes its appearance. Graefe calls the condition interstitial optic neuritis. The pathologic anatomy corresponds to the clinical observations in that only seldom does meningitis occur as a result of intraocular inflammation. The following observations are reached according to the literature and his own observations.

The cause of the degeneration of the optic nerve following intraocular inflammation is the toxins produced by bacteria.

The toxins lead first to an injury and destruction of the ganglion cells of the retina and then to a progressive degeneration of the optic nerve.

The degeneration of the medullary sheaths and the axis cylinders is not more marked in the inflammatory cases than it is in the other forms of degeneration or obstruction of the globe.

The degeneration is first noted in the medullary sheaths. They show varicosities, become stratified and finally undergo fatty degeneration.

The Visual Fields, Tracts and Centers

CHARLES P. SMALL, M.D.

CHICAGO, ILL.

This section of the Digest carries the literature from July, 1920 to July, 1921. For previous references see O. L. v. 16, 1920, p. 218.

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DIGEST OF THE LITERATURE

HISTOLOGIC METHODS. **Danis** describes his new method of studying early degeneration of the anterior optic pathways as seen in the different stages following enucleation or exenteration. The various methods of staining employed by Ehrlich, Golgi and Weigert are not applicable here. He uses a silver stain first described by Ramon y Cajal in 1903. **Pick** calls attention to the work of Binswanger, Munk, and his own on visual localization, which preceded that of Wilbrand.

PHYSIOLOGY. Deep localization in the cerebral cortex is the subject of a paper by **Van Hoog.** **Coronat** raises the question whether there are central fixation cones and separate cortical areas or only one cortical area for the macula.

Edridge-Green has advanced a theory of vision which is opposed to the views of a large majority of physiologists; namely, that the rods are concerned in the supply of visual purple which is dispersed from the rods into the cones. The latter, he believes, are the only end organs which are sensitive to light. This challenge has been taken up by Parsons; who in making investigations in comparative anatomy, shows that many animals and birds, such as rays, dog fish, hedgehogs, bats, moles and the night ape, which possess rods only, and owls, mice and rats, which have only rudimentary cones, all can see. The evidence, drawn from the evolution and anatomic structure of the retina, is against the theory that two elements so similar in form and anatomic structure as the rods and cones, should have such diverse functions, as Edridge-Green would attribute to them. Moreover, as Sherrington has pointed out, his theory would leave unexplained their linkage to the retino-optic nerve paths; in fact it denies to one third or more of the fibres of the optic nerve the conduction of visual impulses. See also section on Color Vision.

STUDY OF VISUAL FIELDS.—**Ashikaga** used for his investigations of the blind spot the blood vessels in the macula and scotomata a white field on which were two black points. One of these points was the object of fixation, and the other corresponded to the blind spot. The test object was a small (5mm.) area of blue, with which the smallest impairment of field became evident. In this way minute scotomas and the shadows of the retinal vessels in the region of the macula were revealed.

Lang points out the importance of accuracy in the technic of perimetric examinations. He objects to the blackboard method of examination because the patient observes the marks and is therefore liable to be influenced by suggestion. The limited field in this method is another objection. Some observers prefer the Bjerrum screen method, with the patient at a distance of from one half to two meters. Elliot's scotometer is virtually a Bjerrum screen mounted on a circular board, which can be rotated around its central point. It is more rapid in use than a Bjerrum. The author believes that the most accurate field can be taken with a Bjerrum screen, tho with care an equally accurate field can be taken with a perimeter.

From studies of quadrant hemianopsia **Rönne** concludes the situation of the macula fibres in the occipital visual tracts is such that they are interwoven from both quadrants; so that injury to one set will eventually affect the other. In making an experimental study of the visual fields, **Polack** finds that the normal field is larger than is generally recorded. The narrowing of the fields is caused by chromatic aberration. **Hess** has written on variations in the visual field.

Zade found that workers who continually look at bright sky frequently have ring scotomata. It usually begins as a small temporal scotoma, then becomes sickle shape and later develops into a ring scotoma. It is generally found 45 to 50° from point of fixation and usually is 10° broad. The author found this condition in a number of persons who were engaged in telegraph service.

Double hemianopsia is rare or perhaps rarely diagnosed. **Jacqueau** reports two interesting cases. In the first there was a right hemianopsia, which gradually progressed until there was vision only in the macular area. Then left hemianopsia developed, with macular vision only. The latter gradually disappeared; and their remained the simple right hemianopsia, which continued stationary. In the second case, there was double hemianopsia without even macular vision so that there was total blindness. **Francioni** has reported a case of left homonymous hemianopsia with right hemiplegia. **Hikita** has written on defects of the visual fields, and **Wolfflin** on central scotoma.

Smeesters shows the different varieties of visual fields in nervous and hysteric conditions; the field of an hysteric showing marked differences from that of a neuresthenic, while a hysteroneuresthenic exhibits still other modifications. By a perimeter, recently devised by Vincentiis it is claimed the fields in this class of cases can be more accurately outlined.

Psychology of Vision. **Vandegrift** gives an illuminating exposition on the various complex factors which produce binocular single vision. In analyzing the spatial concept, he endeavors to prove that it is not entirely an ocular production; and that while the function of vision is a primary factor, the concept may rest upon monocular as well as binocular perceptions. The sense of the solidity and depth are neither essentially ocular, tactile, nor muscular; but a complex of these sensations acted upon by the association of our ideas, in which memory and experience play an important role. The completed concept is the result of a constructive mental function. In the first part of this paper, a comparison of this ocular function is made with that in some of the lower animals; birds, fishes and reptiles.

In an extensive article on the psychology of vision, **Fergus** states that we do not see objects themselves, we only interpret the sensation to which they give rise. Ultimately sight is only the mental interpretation of physical phenomena. The sense of sight is really a mixture of at least five different functions; namely, 1. form sense, 2. reading sense, 3. light sense, 4. color sense, 5. distance sense or perspective.

The problem of vision is thus an extremely complex one.

Farigoule wrote a book on extraretinal vision. The author observed that blindfolded subjects behaved as if they saw objects, persons, and in some instances, written characters. This phenomenon, he believes can be explained on the theory that the hederiform bodies, i. e. cutaneous nerve endings, are similar to the compound eye of insects, and are ocellary retinae with nerve fibers, capable of carrying impulses to the higher cerebral centers.

Gordon made a series of observations and experiments in special schools for mentally defective children, in London and Middlesex, on left-handedness and mirror writing. His theoretic conclusions are that there are undoubtedly some peculiar and uncommon characteristics among some of the left-handed children in mental defective schools, especially among those who write with the right hand. There seems to be no adequate reason for believing that naturally left-handed children should be more prone to mirror writing than the naturally right-handed. As an explanation, the hypothesis is suggested that something has occurred to interfere with the proper functioning of the dominant hemisphere; in the majority of the cases described, it is the left hemisphere. Such a supposition would explain why there are so many left-handed in mental defective schools. The same cause has probably affected the functioning of many of the higher intellectual centers, supposed to be situated in the same hemisphere, involving such peculiarities as mirror writing and defective speech. It would also explain why, in the case of left-handed and right-handed twins, the left-handed twin and not the right-handed twin is found in the special schools. Space perception thru the eyes is the subject of a monograph by **Hofman**; **Koellner** has written on the differentiation of impressions received by the right and left eye, and on the law of direction and localization in peripheral vision. **Lohmann** has taken up the apparent size of the sun at the horizon and the form of the firmament, and also reports on the experimental destruction of binocular vision. **Pech** has written on vision in relief, and **Pflügk** on the visual sense. **Roelofs** and **Zeemann** write about correspondence of contours. **Castresana** reports the impressions of a blind girl who began to see at 16. **Bard** has written on the suppression of the blind spot in the visual field and the localization of images. **Filehne** has discussed impressions of size and briliancy of the heavens, and **Haenel** ocular stimulation thru sound.

WORD BLINDNESS. **Wallace** shows that, in articles and books on the intelligence of mentally subnormal school children, congenital word blindness has been largely overlooked as a specific defect or as a possible factor in the pedagogic retardation of the pupils. He quotes from an analysis of 95 consecutive cases whose reading disability has been attributed to visual aphasia or dyslexia. The diagnosis, the lesions connected with the condition, the average age, sex incidence, etc. are taken up. Special reading disability classes, for word blind children who are not feeble minded are strongly urged.

Three cases of congenital word blindness were seen by **MacLeod**. Two of the children were mentally defective. With the exception of word blindness, the third child was normal.

Wood points out the importance of inheritance in the study of congenital word blindness, as this line of investigation will lead to a better understanding of the disease. It would be informing to follow cases to see if the method of transmission in word blindness follows the same course as that of color blindness. **Ley** has reported alexia with hemianopsia.

The interpretation of the various forms of *aphasia* has given rise to a great deal of theoretic speculation. Our knowledge of the subject is very meager; but that there are more or less definitely localized anatomic seats, where the memory impulses of the different sensory impressions are perceived, seems to have been established. Word blindness is one of the less common forms of aphasia; of the two types, the first called by Dejerine pure word blindness, is characterized by an inability to read written or printed words, but with the preservation of the ability to write. This form is usually accompanied by a right homonymous hemianopsia. The second, rarer type combines visual aphasia with agraphia. **Howe** reports a case corresponding to the second type, in a man of 55, who suddenly became unable to read written or printed matter. There was no paralysis, anesthesia or hemianopsia. Figures were noted correctly and without difficulty. The lesion in this case is probably located in the white matter of the angular and supramarginal gyri, but not extending deeply enough to involve the optic radiation of Gratiolet.

Aphasia may be produced by a lesion situated in any portion of the speech zone. Cases of pure word blindness are rare, and very few instances of it are recorded since Dejerine first called attention to it. **Gordon** reports a case where the patient is unable to read printed or written words. Spontaneous speech, singing, understanding spoken words are all carried on correctly. Reading aloud and mental reading are impossible. The patient sees the written words but is utterly unable to make out the sense of the words. Two interesting phenomena are present; First the verbal blindness is only with regard to words but not to figures; the patient is able to add, subtract, and carry out other arithmetic operations; Second, there is a right homonymous hemianopsia.

Fossataro reports a case of word blindness, following a fracture of the skull in the left parieto-occipital region; **Hartenberg** word blindness with epilepsy and **Mendel** intermittent word blindness.

HYSTERIA. **Lewis** reports a case of hysteric blindness in a young man of 22; a foreign body in one of his eyes had caused him some annoyance for two days; and suddenly, while engaged in his work as accountant, he became blind in both eyes, so much so that he had to be led to the office. A cinder was found in his left eye, which had undoubtedly focussed his attention upon his sight. The boy was unable to distinguish light, but said he saw black streaks like pencils before his eyes. He had been in the army and was shaken up nervously. On being reassured, he was much better in twenty-four hours, and had entirely recovered in another twelve hours. **Byschowski** reports two cases in which patients blind from war injuries failed to recognize their own blindness.

Under the title, Psychology of the Special Senses and their Disorders, **Hurst** publishes his Croonian Lectures dealing with this disease. He defines an "hysterical symptom as one which has been produced by suggestion and is curable by psychotherapy." Abnormal suggestibility is a predisposing cause, but cannot be regarded as a disease; any one may develop hysteria if the provocation is sufficiently great. In his chapter on Seeing, Looking and Hysterical Blindness, Hurst points out that: "in order to see it is necessary to look." Soldiers, in the stupor following exposure to exceptionally terrifying ordeals, would appear to be blind, deaf and anesthetic. The pupil contracted sluggishly, and there was no visual-motor, "flinch" reflex.

He reports a case of shell concussion, the man being discharged as permanently disabled with a pension for total blindness. He lived for four years as a blind beggar, and was found to have pupils widely dilated "with no trace of reaction to light." Treatment by explanation of the condition, promise of cure, and urging the patient to try to see caused some improvement the first evening; and the next day brought vision up to 6/24. Four months later the man was working as a watchmaker and gramophone repairer. In a case of wound in the occipital region, believed to have caused organic blindness, there was found some months later hysteric blindness in three quadrants of the visual fields, the nature of which was not suspected until it disappeared when the man was treated by suggestion for hysteric deafness.

Other cases reported include hysteric blepharospasm; ptosis and amblyopia of 4 months duration; hysteric ptosis with unilateral blepharospasm and amblyopia; ptosis with over action of the frontalis; left ptosis and facial paralysis with right facial spasm; hysteric blindness of 26 months duration; hysteric blindness in a squinting eye; hysteric hemiplegia and hemianesthesia with total blindness cured by psychotherapy. In one case of five years standing, following a wound of the head, there was photophobia with attacks of headache and loss of consciousness. One day, after full explanation and promise of cure, the patient was able to walk in the sun, without his dark glasses and without headache, and in five months no further attacks had occurred.

Westphal discusses a case of blindness without changes in the fundus. The patient came to the pyschiatric clinic from another hospital. Spinal fluid, general physical examination and eye grounds were normal. The patient complained of pain in the back of the neck. There was frequent vomiting. There were great changes in the mental state so much so that she was transferred to an asylum. Occasionally she would complain that she could not see clearly and later it became evident that she was blind. Hallucination of vision and hearing developed. After a year she again could distinguish light. There were no fundus changes and the pupils reacted to light. Severe epilepsy developed. It was never possible to take the visual fields. Later the vision improved so that she could read handwriting. Was the failure of vision due to organic cause or was it a functional psychogenic amaurosis?

The condition lasted eight years. Taking this into consideration together with the psychic changes and the epilepsy which developed, it is thought that it was of organic origin. No case of hysteric blindness lasting over eight years has as yet been reported. It was thought that there was an encephalitis of the occipital lobes. The question of the origin of encephalitis being the cause of amaurosis is especially brought out in a case of Uhthoff's. He lays special stress on the fact that cases of blindness occurring suddenly late in life, with normal ophthalmologic appearance, are due to toxic causes (uremia, cachexia or carcinoma) or bilateral hemianopsia due to softening of the occipital lobes.

Oguchi and **Shima** report the rare occurence of a double ring scotoma with monocular diplopia, in an hysteric woman of 18. The inner ring went thru the blind spot. The condition, however, often changed in that the external ring or both disappeared occasionally, when the patient felt well.

Augstein reported several cases of hysteric amaurosis due to injury or benumbing of the higher cortical centers. He states that cases may be cured even after 21 months of blindness, by suggestion while the patient is awake and at the same time using the Faradic current. In some cases, injection of salt solution, subconjunctivally, is sufficient. In others, hypnosis will effect a cure.

Smith demonstrated a case of blindness in a little girl, eight and a half years of age, whose left eye had been totally blind for a period of six days after she had received a blow on the head. The child was rather delicate, but of a bright and cheerful disposition. The eye appeared normal and the pupillary reactions were present, and this fact had raised his suspicions. When the right eye was bandaged, she was unable to walk without colliding with objects in her path; flicking the fingers before her left eye did not make her blink, nor did she flinch when Dr. Smith pretended to poke his finger in her eye. He tested her sight with red and black letters, which she could easily read. These observations showed that the case was one of hysterical blindness; and the patient had since recovered her vision perfectly. In the discussion, members agreed that the condition was hysteric. **Salterain** reports hysteric amaoursis in a girl of 14,

Steinitz hysteric amaurosis and abasia, and **Schwartz** unilateral and bilateral blindness in hysteria.

Hansell reports an unusual case of blindness coming on suddenly in one eye, sixteen months after an injury, which had caused blindness in the other eye. The patient had received a shrapnel wound about the junction of the right parietal and temporal bones. The right eye was apparently but slightly injured, but both eyes were bandaged for several days. On removing the bandages, the right eye was found to be blind, and has remained so without any return of light perception. The left eye was uninjured and its vision unimpaired. The fundus picture of the right eye afforded no explanation of the total blindness. Exhaustive physical examination gave negative results. The case must be either organic disease of the brain, hysteria or malingering. The last hypothesis can be dismissed because of the tests employed. It was probably one of organic central disease, altho the reasons for this supposition are not absolutely convincing. Dercum, in discussing the case, was inclined to believe it was one of hysteria to be classed with shell shock cases.

HALLUCINATIONS. Visual hallucinations, occurring in the presleep state, are frequent problems for the clinician. The phenomena differ in various ways. Some are pathologic and some are not. In four cases observed by **Lord,** two things are emphasized, namely, the quality of ultrared objectivity felt by the perceiver, and the degree of alarm experienced at the moment of illusion. Wilmer has described visual hallucinations in carbon monoxid poisoning.

Livet reports a case of general paralysis of syphilitic origin, in a woman of fifty-three, in which there were constant hallucinations.

Four cases of unusual form of migrain were reported by **Pichler.** In one, there was sudden loss of vision, which lasted ¼ hour and was followed by permanent limitation of the visual field of the upper outer quadrant of the left eye. The second case had hemianopsia and diplopia with temporary loss of accomodation. The third became dizzy and had diplopia, and the fourth had a partial hemiplegia, with limitation of the left lower visual field, which cleared completely in 14 days. The author concludes that these symptoms are due to disturbance of nutrition of the peripheral part of the eye. **Keller** discusses the visual phenomena of migrain.

DISEASE OF THE CHIASM. **Parker** reports the case of a brain tumor involving the left optic tract, the chiasm and the adjacent brain substance. The visual fields showed an homonymous hemianopsia, without involvement of the macula. Postmortem examination revealed a large roundcelled sarcoma, involving the right tract, chiasm and adjacent brain substance. The visual fields were of particular interest, showing at first an homonymous hemianopsia, the macula becoming involved later on. To produce the field changes shown, the tumor apparently first involved the right tract, inducing a left homonymous hemianopsia and a positive Wernicke sign. Later it invaded the chiasm or led to pressure symptoms that affected only the papillomacular bundle. Finally a possible bitemporal hemianopsia developed; and this, superimposed upon an homonymous hemianopsia, led to blindness in one eye and a loss of temporal field in the other.

Le Chat observed 30 cases of bilateral hemianopsia with retention of central vision. In 22, vascular disturbance, such as hemmorrhage and embolism, was the cause. Traumatism was the cause of 8. In all cases, peripheral vision had been lost almost to the point of fixation. The author believes that this adds to the evidence that there is a cerebral center for the macula.

Laconture and **Charbonnel** never operate hypophseal tumors until after consulting with the neurologist and ophthalmologist. An outline is given of the various operative technics.

Bollack and **Hartman** described a case with tumor in the region of the hypophysis, in which there was a homonymous hemianopsia, paralysis of the right third cranial nerve, slight swelling of the right disc, and adiposis genitalis. The sella turcica was enlarged.

In a rather exhaustive paper, **Rasquin** points out the numerous symptoms produced by tumors of the hypophysis. He gives in detail the symptoms and entire case history with autopsy findings of a case of sarcoma of the hypophysis. **Mingazinni** has described the clinical and pathologic anatomic findings of tumors of the hypophysis.

Quick points out that, even with the advance made in pituitary surgery in the past few years, it does not represent by a wide margin the ideal treatment for tumors in this location; and consequently many other methods have been tried. During the past few years, X-ray and radium have been used more and more. While the results of this work to date are very incomplete and contradictory, reports from many who have been trying this method are encouraging. Reports from different observers show that the most marked improvement was the more or less complete disappearance of headaches, dizziness, nausea and vomiting. In several instances, there has been decided improvement in vision.

Experiment in the use of radium, at the Memorial Hospital, N. Y., on three cases, showed favorable results and warrant them in looking forward to future work in this line with considerable optimism. Three factors stand out in favor of treatment by X-ray or radium: 1. There is no operative mortality. 2. Pressure symptoms respond much more promptly, without pain or inconvenience to the patient. 3. Radiation offers a hope to every case of pituitary tumor, whereas surgery is confined to a small group of hyperplasias and benign tumors. **Kuttner** reports the successful treatment of malignant tumor of the hypophysis with radium, and **Gravezzenski** one cured by X-ray.

Hughes reports a case of myxosarcoma of the pituitary body, extending upwards into the optic thalamus, filling up a considerable portion of the third ventricle and exerting a severe pressure upon the chiasm. The patient has a boy nine years old. The symptoms of acromegaly were present, but there was a very rapid onset of blindness and intense headache.

Bryan reports a case to show the relation between cerebral tumor and acromegalic symptoms. The patient under observation had been in different hospitals for about two years, with the diagnosis of acromegaly, the tumor mass not being suspected. He died, apparently of bronchopneumonia. Autopsy revealed a large, nodular, irregular tumor over the right parietal and occipital region. In spite of the long standing disease, the pituitary was only slightly enlarged and retained its original form. The eye symptoms, which had been present, were slight. The left pupil was larger than the right and both reacted fairly well to light and accommodation. Vision of the right eye was 20/40, and of the left 20/50. The fundi showed some evidence of choked discs.

Poyales, in a paper with numerous illustrations, gives a resumé of the different varieties of visual disturbances following lesions in the hypophyseal region.

Stieren reports a case of a forty year old man with enlargement of the pituitary body. There was complete right, temporal hemianopsia. After administration of eight grains of whole pituitary gland, every twenty-four hours over a period of six weeks, there was a gradual but undoubted improvement in several respects. The field of vision advanced almost ten degrees from the fixation point. The headaches were entirely relieved, and his general, mental and physical condition improved.

A case of pituitary tumor, in a cabinet maker of 47, is reported by**Behse.** It was accompanied by acromegaly and temporal hemianopsia. He compares this case with others on record and emphasizes the great improvement realized under pituitary treatment, three to ten tablets a day. The excessive thirst abated, as also the somnolency, profuse sweating and glycosuria; the sugar dropping to 2.5%. The man was able to return to work, and vision improved to nearly normal in one eye and the other could count fingers at three meters.

De Schweinitz concludes that the ocular symptoms depending upon pituitary body diseases due to acquired syphilis, are not characteristic and are the same as those which occur in nonsyphilitic persons. Cases of pituitary body disease with exterior ocular muscle palsies, probably occur more often in luetic subjects. If a patient who has acquired syphilis, develops hypophyseal disease, and the ocular symptoms do not improve under active specific treatment, surgical interference should be instituted. Thoro examination of the eye grounds, especially in the periphery of the fundus, should be made; chorio-retinitis may be found when nô other stigmata of syphilis are present. It is probable, that a combination of thyroid and pituitary gland extracts is more effective than either of the extracts alone; and when mercury (preferably by inunctions) is given at the same time, the organotheraphy is enhanced.

The author classifies hypophyseal disease occurring in syphilitic persons, as follows:

1. In subjects of acquired syphilis, but the pituitary body lesion not necessarily, and probably not itself, syphilitic.
2. In subjects of acquired syphilis and the pituitary body lesion definitely and in all probability, syphilitic.
3. In subjects with negative serologic tests, but in whom the favorable results obtained following antiluetic treatment, combined with pituitary body and thyroid gland feeding, was suggestive.

Case reports illustrating the various classes are incorporated in the article. **Van Gangelien** has reported syphilis and sphenoidal disease with a temporal hemianopsia.

Webster showed a case with hypophyseal tumor, in which the visual findings were characteristic. The X-ray pictures showed changes in the sella.

Sisaric mentions a case of sudden blindness in a case of tubercle of the optic chiasm. The patient, a man of thirty-seven years of age, had an ileocecal tuberculous tumor. Later he complained of visual disturbances and shortly became completely blind. Examination showed wide and fixed pupils. There was temporal paleness of both papillae. Treatment was of no avail. The clinical diagnosis was tuberculosis of the cecum with metastatic focus in the optic chiasm and upper part of the spinal cord. The post-mortem showed a focus in the posterior part of the cord in the lower cervical region. All the thoracic cord was softened. The chiasm showed serious changes in the center, the lateral parts being intact. It was a conglomerate tubercle, not of recent date. There were older and younger portions of the growth. Both optic tracts showed some intact fibers. The patient must have had hemianopic defects without noticing them before he became blind.

Fehr reported a case of suddenly developing bitemporal hemianopsia, which occurred in a woman during pregnancy. The sella turcica was enlarged. There were no other signs of hypophoseal disease present. After the termination of the pregnancy, the condition remained stationary. The author assumed that the pregnancy stimulated an existing adenoma of the hypophysis to growth, and that the enlargement ceased after the birth of the child.

Benedict emphasizes the value of ocular changes in making an early diagnosis of pituitary body tumors. Loss of vision with changes in the visual fields, should excite one's suspicion and lead to a request of a careful examination including X-ray pictures of the skull. The author has observed in a number of cases which came under his care, a peculiar pallor of the disc without atrophy. The nerve head has a waxy appearance but there is not loss of substance nor contraction of the retinal vessels. Excellent colored plates illustrate changes in the nerve head.

LESIONS OF VISUAL CENTERS. **Barrett** reports "fleeting amaurosis" in a girl of nine years who complained of pain in her head and eyes with better vision in a dim light. When examined both pupils were widely dilated and fixed. The fundus and media were normal. Vision R. 6/36; L. 6/60. Two days later the vision rose to 6/9, but the pupils were still inactive and dilated. Complete recovery took place in eight days. Barrett considers the case remarkable and corresponding to the type known as acute cerebral, or post-convulsive amaurosis first described by Nettleship (1884) and Gay (1893). The disease remained practically unrecognized until Stephenson discussed it fully in 1905 and applied the term fleeting amaurosis. It is attributed to disturbances in the visual cortex, but this hypothesis fails to explain the dilatation of the pupil. The motor disturbance, ptosis or retraction met with may be explained by involvement of the motor cortex. Barrett has seen several cases with recovery in every case.

David reports the case of a young boy who, following an attack of grippe, developed a double amaurosis with violent headache, vomiting and hypertension of the cerebrospinal fluid. Lumbar puncture was followed by amelioration of the symptoms and a rapid return of vision.

Sage reported three cases of central blindness, which occurred in a brother and sister and a first cousin. The etiology was undetermined. **Vincent** reports amaurosis with lethargic encephalitis.

Beaussart describes what he regards as a unique case, a man of nearly 44 with old syphilis developing a set of symptoms suggesting a lesion in the thalamus, with hemianopsia, visual hallucination, generalized and Jacksonian epilepsy with unconsciousness. The symptoms suggested a general paresis, but their tertiary character became manifest during the six months before death. A widower at 40, he had married a gay young wife at 42, and she left him after six months. Syphilitic pseudobulbar paralysis with hemianopsia with alexia is reported by **Haldo.**

Mingazini discussed the ocular symptoms of abcesses and tumor of the brain. In regard to the different theories, as to which side a patient tends to fall, in a condition of localized cerebellar tumor, **Williamson** reports a case under his observation. A man of 45 had, as the atrophy showed, a cerebellar tumor situated at the posterior half of the middle lobe and extended to the left lobe, affecting almost the whole of the posterior half of this lobe. Definite tendency to fall backwards and to the left, when walking, was marked.

After calling attention to a few physiologic facts ascribed to the cerebellum, **Steuber** gives the history of a case of sarcoma of the cerebellum, in an eight year old boy, who died about eighteen months after the first symptoms became manifest. The ocular changes, which showed themselves during the course of the disease, were somewhat unusual. Vision remained practically normal, tho there were slight choked disc, horizontal nystagmus, and retinal hemorrhages and infiltrations.

OXYCEPHALY.—A case of oxycephaly and nanism, in a girl 21 years of age, is reported by **Isola.** At the age of two years, vomiting and headache were followed by progressive loss of vision. At the present time, she was totally blind, with reducible exophthalmos and horizontal nystagmus. The skull showed scattered depressions, where the convolutions of the brain had exerted abnormal pressure on the inner table, inducing rarefaction. The retrospective diagnosis is that an attack of hydrocephalus injured the pituitary in early life, and the dwarf growth was secondary to this. She was only 1.3 m. in height.

Schlivek reports a case of oxycephaly in a man of 28. He exhibited the characteristic symptoms of this condition; the skull deformity and optic atrophy. He also had the most common accessory symptoms; exophthalmos and divergent strabismus. Treatment of this condition should be directed to the alleviation of the intracranial pressure during the stage of development, i. e. before the seventh year. **Santos Fernandez** reviews the literature on oxycephaly.

Thompson exhibited a case of oxycephaly in a one year old child. The child showed an extreme degree of this deformity, the eyes being very protuberant, and the vertex of the skull very high. The occiput was but little developed. An especially interesting feature was that the early age of the infant permitted an increased intracranial pressure to be readily recognizable. The anterior fontanelle was widely open and bulging, and the posterior fontanelle was also open. The frontal bones were separate. No other deformity was present and the intelligence was good.

Watts believes that early decompression, to relieve the increased intracranial pressure in cases of oxycephaly, would often prevent optic atrophy, which so frequently accompanies this skull deformity. Twenty cases of this kind were reported from one institution for the blind in Germany. Watts reviews the etiology, signs and symptoms, and reports a case in which a bilateral, temporal decompression was done. The general condition was improved and the vision also. **Rieping** discusses the pathogenesis of tower skull.

A 21 year old girl was shown by **Massie,** who complained of inability to see properly from her right eye, owing to increasing depression of the eyelid. She also complained of headaches. Radiograms showed diffuse absorption of bone and overgrowth of imperfectly defined, new, cancerous growth, affecting the right frontal bone. Both horizontal and vertical plates were affected. Osteitis fibrosa was suggested. The girl was unwilling to have an operation.

WOUNDS INVOLVING VISUAL CENTERS.

Three cases of homonymous lateral hemianopsia, following gun shot wounds of war, are reported by **Elewaut.** In the first case, a fragment of shell struck in the right occipital region, There was prolonged coma, typical, lateral, homonymous hemianopsia, and conservation of macular vision. The visual acuity was very poor, considering that the eye was emmetropic and presented no lesion; but the diminution of visual acuity was due to meningitis having affected the cells of the occipital visual center. In the second case of typical lateral homonymous hemianopsia, loss of the left field of vision had followed a wound of the right occipital region. The third case was one of right, inferior quadrant anopsia, which followed injury by a fragment of shell striking the left parieto-occipital region.

McDavitt reports a case of lateral homonymous diplopia, resulting from a bullet wound. The bullet entered above and slightly to the rear of the left mastoid. The right side of the body was paralyzed. The vision of each eye was 20/30, looking directly in front; but the entire right field was blind, not even light perception on this side.

Fleischer and **Ensinger** report on 67 cases of gunshot injury of the skull under the following headings:

1. Unilateral and chiefly unilateral hemianopsias; (a) right sided hemianopsia; (1.) Merely right sided hemianopsia. (2.) Chiefly right sided hemianopsia with participation of the left half of the visual field. (3.) Right sided quadrant hemianopsias. (b) Left sided hemianopsias with the corresponding subdivisions.

2. Bilateral hemianopsias; (a) inferior hemianopsias; (1.) Pure inferior hemianopsia. (2.) Chiefly inferior hemianopsia with participation of the upper field. (b) Superior hemianopsias.

3. Hemianopic Scotomas. (a) Central scotomas. (b) Paracentral scotomas extending to the point of fixation. (c) Scotomas outside of the macular region. All are illustrated by charts of the visual fields.

With regard to principle questions, the intactness of the macula was found 27 times, its participation 5 times. These phenomena are differently explained by different authors. Case 27, with injury of the posterior pole of the brain and intactness of the macula, spoke for the theory of Levy of the double supply of the macula. Case 10 made this explanation superfluous because a later examination disclosed an improvement in the form of a peripherally progressing recovery of the macular region. The starting point for a peripherally progressing regeneration must certainly be sought in an intact macular region of the same side. Otherwise the assumption of double supply is rendered improbable by the occurrence of central hemianopsic scotomas and of the circumscribed scotomas of the macular region extending into the point of fixation. The disappearance of the macular quadrant after operative removal of the projectile is not compatible with a double supply, as here the adjoining macular center towards the pole or the corresponding fibers were damaged by the extraction.

An encroaching of the defect, upon the intact visual field in the macular region, occurred in cases 15 and 16. In both according to the seat of the injury, a destruction of both macular centers is easily intelligible.

Pagenstecher has written on visual troubles after wounds of the occipital region.

Jackson reports the case of a soldier who was wounded by a large fragment of shell case, which entered the right occipital lobe, carrying with it a portion of cap, hair and bone fragments. After convalescence, it was seen that he had an almost complete hemianopsia.

Color Vision

Burton Chance, M.D.

PHILADELPHIA, PA.

This section of the Digest carries the literature from July, 1920, to July, 1921. Closely allied topics are found in the section on the retina, p. 218. For previous references, see O. L., v. 16, 1920, p. 231.

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DIGEST OF THE LITERATURE.

Physiology and Theories of Color Vision.—By far the most momentous contribution to the literature of color vision in recent years has been the publication of **Edridge-Green,** on "The Physiology of Vision with Special Reference to Color Blindness," which appeared in 1920, and has already been noticed in the American Journal of Ophthalmology. (v. 3, p. 845.)

In this book the author incorporates the substance of many communications which he has contributed to various scientific societies on the subjects of the physiology of vision and of color vision. Accompanying the work is a new test card for the detection of color blindness. A valuable section of the work is that devoted to the description of instruments elaborated by the author for the examination of color vision.

It has seemed proper to present in detail much of what has been offered in criticism of this work, because Edridge-Green's investigations and observations have continued over a long series of years; and the results which he publishes, and the theories he advances are at variance with what have been accepted and held by the majority of the foremost workers in this division of science. He does science a service in bringing together into a single volume a summary of his labors, because he therein embodies the essence of what might be accepted as the "Edridge-Green Theory of Color Vision."

The discussions and criticisms have been found in the lay newspapers as well as in the medical, ophthalmologic and general scientific journals.

Anyone who desires to ascertain for himself to what extent the discussion has gone may read the letters of **Dunn, Parsons,** and **Edridge-Green** in the issues of The Lancet. One finds in the discussions highly polemic and personal references; it is even stated that Dr. Edridge-Green "often does not mention views opposed to his own"; "that many of the main facts of the subject are incorrectly stated"; and, "his theories when contrary to previous views are usually untenable." And altho Edridge-Green states "that all other reviewers (than Parsons) have been favorable to his views," it is replied that "even if this were correct, it is hardly the sort of argument to appeal to scientific workers."

The Medical Press, however, after speaking of the hostility shown towards Edridge-Green's researches in color vision states that he declared that the once universal color test used by means of wools, based upon the trichromatic theory was defective on the ground that in addition to rejecting many normal color sighted persons, it allowed over 50 per cent of dangerously color blind persons to escape detection. "No one," continues the Medical Press, "has been able to prove that his deductions are unworthy of support, or that his conclusions are wrong; and ophthalmologists and psychologists are now accepting his views and are gradually incorporating his theories in their teachings. His lantern test has been accepted in the British Navy and the Navies of the U. S. and other foreign countries, as well as on many railroad systems."

The gist of **Edridge-Green's** theory, according to The Lancet, is the removal of the color discriminating faculty from the retina where the theories of Helmholtz and Hering had placed it, to the brain, where, he postulates a center for the distinguishing of color, higher up than that for distinguishing form. The number of colors that we are able to distinguish depends on the extent to which this color center is developed; the dichromic being able to distinguish only two, and these the farthest apart in the spectrum; the trichromic three, and so on, most of us having arrived at the stage of distinguishing six definite colors, while the exceptional individual is able to distinguish seven. So far, the theory is easy to grasp. The distinction is further drawn between "approximate psychophysical units" and the "absolute psychophysical units," the former corresponding to the number of different colors seen and the divisions seen in the spectrum; the latter units, for any individual, may be about three times as numerous as the former.

The psychic theory of color vision appears to fit in far better with observed facts than either of the older theories. An obscurity which needs explaining is the occasional existence of color blindness varying in degree in the two eyes of the same individual. Such a case is given with much detail in the author's earlier writings, and his theory is obviously incomplete until it is explained. Besides the degree of development of the brain center it would seem that there must be some variability in the retinal apparatus by which the light waves that cause the sensation of color are transmitted as nervous impulses and that this must be different in the two eyes. Such an explanation is hinted at by the use of the phrase—"retinocerebral apparatus"—but it is not worked out.

In the "Times" may be found an interesting account of the history of Color Vision; and informing reviews, in "The Philosophical Magazine," and in "Nature."

The chief points under criticism will now be taken up, and detailed sufficiently for the general reader to obtain an idea of the facts in dispute. Edridge-Green states: "The cones are the terminal perceptive visual organs. The rods are not perceptive elements, but are concerned with the formation and distribution of the visual purple. Vision takes place by stimulation of the cones thru the photochemical decomposition of the liquid surrounding them, which is sensitised by the visual purple."

Parsons disputes the proposition and presents, in favor of their being perceptive, the evidence supplied by comparative anatomy, and would remind the author that there are seeing animals which possess only rods, and there are other animals which possess only cones, which facts negative the theory, at least as far as such animals are concerned, that the cones are activated by the visual purple secreted by the rods. The cones are regarded as probably insensitive to low intensities of light, in the dark adapted eye, and are concerned with photopic or color perceiving vision, and it is believed that the rods are specially sensitive to low intensities of light in the dark adapted eye, being concerned specially with scotopic or achromatic vision.

In answer to this, **Edridge-Green,** invites attention to page 54, of his book. "It was formerly stated," he quotes, "that a tortoise possesses only cones, but on examining the retina of a tortoise I found the rods and cones as definitely marked and distinct from each other as in man." This argument therefore is valueless. And again on page 50. "Many physiologists have tried to assign different functions to the rods and cones, but all these theories have failed, because all the functions which were said to be the exclusive property of the rods have been found only gradually diminished in the fovea. For instance, von Tschermak, Hering, Hess, Garten, and I have found the Purkinje phenomenon, the variation in optical white equations by a state of light and dark adaptation, the colorless interval for spectral lights of increasing intensity, the varying phases of the after image, in the fovea, only gradually diminished. The complete absence of any qualitative change between the foveal and extrafoveal regions is a very important fact in support of the hypothesis that the visual purple is the visual substance."

As most competent observers (using the most refined methods), according to Parsons, are agreed that Purkinje's phenomenon is absent at the fovea, such absence supports the view that the cones play no part in scotopic vision. Purkinje's phenomenon, on the contrary, supports the view that two different mechanisms are at work in scotopic and photopic vision, the former being carried out by the rods, and the latter mostly by the cones. And, as the visual purple is found only in the rods, it is justifiable to conclude that the rods and visual purple are specially concerned with scotopic vision. Moreover, the accumulation of the visual purple is essential for dark adaptation.

Of the changes in the value of color matches on altering the intensity of the light and the state of *dark adaptation,* in general it may be said, as pointed out by von Kries; that matches valid for high intensities become invalid for low intensities, and dark adaptation, in the sense that the mixture which possesses the greater rod value, exhibits the greater luminosity in tone free scotopic vision. König has concluded from his observation of the visual acuity with white and monochromatic lights, that two different elements of the percipient layer of the retina are involved, and that under low intensities of light, vision is due to the activity of the rods, under higher intensities to that of the cones.

When two lights of different brightness, whether of the same or of different colors, are alternated, flickering is observed. If the rate of alternation is gradually increased a "critical frequency" is ultimately reached at which the flickering disappears. The *flicker phenomenon* is dependent entirely upon the brightness of the lights and not upon their color.

There are cases of congenital total color blindness in which light is perceived but no colors. In these cases the brightness values of spectral lights correspond with those of the normal dark adapted eye stimulated by lights of low intensity. The process of dark adaptation pursues the normal course in the totally color blind, and Uhthoff, and von Kries, have shown that the flicker phenomenon follows the same laws as in the normal achromatic scotopia. All color blind individuals have marked diminution of central visual acuity and in many cases there is undoubtedly a central scotoma. In these cases cone vision is almost, if not entirely in abeyance, and vision is carried out by means of the rods.

In *night blindness* dark adaptation may be much slower than normal or almost abolished; in high degrees it is both slowed and diminished. The higher degrees of sensitiveness of the retina are never reached, and the highest possible are reached only after prolonged exclusion of light from the eye. Color vision is normal with the exception of occasional diminution of sensibility for blue lights. Purkinje's phenomenon is much less marked in the night blind. These cases can be explained on the hypothesis that rod vision is seriously disturbed or in abeyance. The pathology of retinitis pigmentosa supports this view. This disease is due to vascular degeneration in the choroid whereby the choriocapillaris is destroyed, and the outer layers of the retina are dependent for their nutrition upon the integrity of the choriocapillaris. From its proximity, the pigment epithelium must suffer first.

The production of visual purple in the rods is undoubtedly bound up in the integrity of the pigmented epithelial cells, so that primary disorder of the functions of the rods might be confidently anticipated on the pathologico-anatomic grounds. It is a rule in most nutritional disorders for the most highly differentiated and complex structures to suffer first. That there is good evidence of a survival of the cone functions after destruction of the rod functions is evidence of an intermediary process such as that described.

Parsons is compelled to exclaim that 'it seems almost inconceivable that two structures so similar in form and composition, in position and anatomic relations, should have such diverse functions as are attributed to them by Dr. Edridge-Green.' Even in the human retina intermediate forms are seen of such a nature that it is difficult to determine whether they are really rods or cones, and in the fovea itself the cones are elongated and cylindrical, resembling rods more closely than elsewhere. Of the two, the cones are the more complex in structure; and the rods are absent at the most highly differentiated part of the retina. The natural conclusion, which is supported by analogy and by comparative anatomy, is that the rods are the more primitive visual element, and that the cones have become differentiated from them in the course of evolution. It is consistent with this view that the rods retain in man the primitive function of mere light perception, whereas the more highly differentiated cones have acquired the more complex function of responding specifically to qualitative varieties of light stimulus.

Sherrington, in his critical review, believes that "the reader will feel that certain facts challenge Edridge-Green's postulates; thus the hypothesis as to the rods leaves unexplained their linkage to the retinoptic nerve paths. It denies to one half, in some animals to much more than half, of the optic nerve fibers, the conduction of visual impulses. It makes difficult the attribution to the fibers of any efferent function."

In addition to these anatomic evidences **Parsons** would present the further argument of the Duplicity Theory of von Kries, which considered the rods as well as the cones as light perceiving elements.

Since Boll, in 1876, discovered that the visual purple was bleached by exposure to light, and more especially since Kühne's exhaustive investigations, a photochemical explanation of the action of light on the retina, has been the most popular. Kühne found visual purple in the rods only, and this observation has been confirmed and is generally accepted. Edridge-Green holds that the substance diffuses into the surrounding fluid and becomes distributed to every part of the outer layer of the retina. He found it between and not in the cones of the fovea. Edridge-Green has described in detail (p. 135 no, 6) "currents seen in the field of vision not due to the circulation; these are formed by the flow of the sensitised liquid." It does not appear at all probable that vision depends upon the wide spread diffusion of sensitized molecules in a fluid medium. If it were, it would be very difficult to understand how the extremely fine discrimination of minute objects, e. g. a visual acuity with a minimum visual angle considerably less than one minute, such as it often met with, could be obtained. It is far more probable that if the process is photochemical the reaction takes place in the neuroepithelium itself. It is also improbable that the fovea, the part of the retina which is most sensitive to photoptic vision, and which is specially differentiated for the discrimination of minute details, should be sensitized by fluid flowing along definite channels from the surrounding areas.

As to the visual purple, according to **Sherrington,** "the author's findings that it floods the fovea contradicts observations by Kühne, Nettleship, and others, tho these are not mentioned in the author's text. When there is most visual purple in the fovea, the author proceeds, it is the most sensitive part of the retina, therefore, where there is none it is blind. Dark adaptation is chiefly due to accumulation of visual purple around the cones. Yet, at the purest cone region, the fovea and in the state of dark adaptation, retinal sensitiveness is, relative to that of adjacent regions, low. Is it not doubtful whether in most individuals the fovea is at anytime the most sensitive region of the retina? Further, will mere accumulation of photosensitive substance carry qualitative change in its reaction, so as to explain the shift of wave length of maximal luminosity characteristic of adaptation? There is no qualitative difference between the visual reactions of the fovea and the parafoveal region. This statement opposes the common result of a number of observers; the reader might expect some mention of the opposed data or of their authorities."

An explanation of this difference of opinion, **Edridge-Green** gives on page 78 of his book. Probably most competent judges will agree that the light stimulus is of a photochemical nature and that the physical basis is one of molecular forced vibrations. They will, however, suspend judgment as to the exact details of the mechanism.

Sherrington continues: "The postulation quoted above of a single visual substance as a basis for vision both colored and uncolored is an attractive one. It gains, too, from a recent mathematically stated theory by Houston. But in the further development of his views, the author on the ground that, to the physical spectrum's series of infinite gradation, there must correspond a psychophysical finite series of units, proceeds to assume the existence of 6 such, in some cases of 7, represented by the "monochromatic divisions," the definite colors seen in the spectrum."

Edridge-Green divides the spectrum into "psychophysical units." Thus, the normal person sees six colors; red, orange, yellow, green, blue, and violet. A further subdivision is into "absolute psychophysical units," according to the number of monochromatic patches which can be distinguished in the spectrum. He says that color blind people have fewer psychophysical units, and may therefore be classified according to the number of colors seen into penta—, tetra—, tri—, and dichromics. The dichromics see only two colors: red and violet: the trichromics three; red, green, and violet; the tetrachromics four; red, yellow, green, and violet: the pentachromic five; red, yellow, green, blue, and violet; the hexachromic six; red, orange, yellow, green, blue, and violet.

The color blind are not consistent in the manner in which they name the colors of the spectrum. Yet in determining the class to which any person belongs, Edridge-Green attaches much importance to the names given to the colors. Now it has always been held hitherto, declares Parsons, that little importance is to be attached to the names given to colors by the color blind, and there is good reason for the utmost caution in this respect. From the psychologic point of view most people agree with Hering that there are only four fundamental colors (excluding black and white) viz., red, yellow, green, and blue. The other colors in the spectrum can be analyzed subjectively into these or mixtures of two of these colors, e. g., orange arouses the sensations of both red and yellow, and there are similar transition colors, which have not received distinctive names, between yellow and green, and green and blue. Of orange, Dr. Edridge-Green says, "to me orange is most definitely a fundamental sensation. I cannot see any trace of either red corresponding to the ruby glass or yellow in pure orange, and the term reddish yellow does not describe orange to me."

From this statement **Parsons** dissents and declares that he does not think that this is the experience of most people with normal color vision. And **Sherrington** states "These psychophysical units, unlike Houston's '3 quantities,' are not continuous variants thruout the series. They have separate thresholds. In the history of life, they have been evolved successively. Their sequence of appearance has been the following: first red ("whitish red") and violet; then green; then yellow; then blue; then orange; and finally, in exceptionally perfect color vision, indigo.

The author does not regard the reproductibility of the entire gamut of color sensations by mixing of 3 of its items (Young's Three-element-theory) as analytically so serviceable as the supposition of the above 6 or 7 units, believed detachable as such by spectral inspection. The identification of these serial units depends partly on the observation that, when the spectrum is gradually increased for liminal intensity, they become severally visible in the above mentioned succession. One has to mark, then, that this order is not in agreement with careful observations on the thresholds of color visibility by Abney, Festing, and by Abney and Watson, observations not referred to in the book.

Hence, in naming the colors of the spectrum, the color blind tho having fewer color sensations than the normal, are accustomed to use several or all of the names in general use. Consequently they make egregious mistakes. It is only after prolonged experience that the color names used by the color blind are found to possess a certain degree of consistency; but at the best, the names given to the colors are a very uncertain criterion of the type of color blindness. That with increasing knowledge of this difficult subject, they will attain greater value as indicators cannot be doubted. Many difficulties in this direction have already been cleared up by the Young-Helmholtz theory.

When we look at the question of color names from another point of view they become of paramount importance, viz, when it becomes a question of deciding whether a color blind person is likely to be dangerous as an engine-driver, etc. Here, if a man calls red green, or vice versa, it is obvious without any further evidence of the exact nature of his color defect, that he is unfitted for such an occupation.

Edridge-Green insists that the use of color names is a practical test for color blindness and is so important as to be essential in a scientific method of classification. By the use of his spectrometer, a key is at once given to one's color vision. A man, who has a neutral point in the spectrum, is definitely dichromic; and, despite all other efforts, he will generally state that there are only two colors in the spectrum. So also may a trichromic be detected, and the naming by these men is quite characteristic. Their color naming is not haphazard nor dependent only upon luminosity.

So far as color names are concerned, they are a very unstable foundation for the scientific classification of various types or degrees of color blindness. If we examine Dr. Edridge-Green's records of dichromics (pp 186-189), we find that tho he says they are all dichromics, the color name which the individuals used varied from 2 to 6 excluding such names as red-green, blue-green etc. Edridge-Green's views on red-green and yellow are rather obscure, see p. 141, Physiology of Vision.

DISCRIMINATION OF HUE. **Edridge-Green,** after dividing the spectrum into "psychophysical units" according to color names, further subdivides it into "absolute psychophysical units" according to the number of monochromatic patches, which the individual can discriminate. For this purpose, he has devised the color spectrum spectrometer. The object of this instrument is to determine the smallest monochromatic patches into which the spectrum can be divided. Parsons thinks it is not difficult to prove that in reality it measures the largest monochromatic patches. He thinks, however, that the observations made with the spectrometer might afford valuable data for statistic inquiry. Edridge-Green states that differences in hue cannot be detected readily without differences in luminosity of the various portions of the spectrum. Exact comparisons cannot be made unless the portions of the spectrum to be compared are of equal luminosity, of equal dispersion and the images fall on exactly corresponding areas of the retinas. His spectrometer was designed for the detection and classification of color blindness and yet when used with a double image prism it fulfills all these conditions.

Color Mixture. "All the colors of the spectrum and of nature can be imitated by mixtures of three selected spectral colors, so that in this sense color vision is undoubtedly trichromatic." (p. 136 Phy. V). This statement which, however, is not strictly accurate, shows that Edridge-Green accepts the fundamental fact of color mixtures, upon which the Young-Helmholtz, or three components theory is chiefly based.

"The simple character of the yellow sensation" argues a point crucial for the author, in the opinion of **Sherrington,** where he states "the impossibility of splitting the yellow sensation into its alleged hypothetic constituents "viz. red and green," "when spectral yellow is used." "The eye may be fatigued with red and green without altering the hue of spectral yellow." But Burch, (Philos. Trans. 1898) by fatiguing with red made spectral yellow appear green, and by fatiguing with green made spectral yellow appear red; and confirmed the observation on 70 persons. "I have entirely failed" he wrote, "though I have sought it carefully, to detect any physical evidence of a separate sensation of yellow." Abney, with a very refined qualitative technic, arrived at similar results. But the chapter makes no reference to the work of these other observers, it is, therefore, unjustifiable for Dr. Edridge-Green to convey the impression that his arguments are unassailable (Parsons).

Edridge-Green is inclined to believe that Burch found with his own eyes a result different from what Parsons states Burch pointed out; and that those who made the observations with Burch did not see as he saw, for Burch himself was unable to perceive more than four colors. Of this set of experiments, Edridge-Green believes none others have given him so many converts.

It is of fundamental importance to Dr. Edridge-Green, Parsons believes, that he should prove yellow to be a simple sensation and not the combined effect of stimulation of red and green sensations.

Relationship of Color and Brightness in the Color Blind. According to Dr. Edridge-Green light perception and color perception are quite distinct, and cases of color blindness can be divided into two classes, according as the defect is one of light perception, or one of color perception or differentiation without any defect in light perception. Both defects may be present in the same individual. The work of Sir William Abney and his collaborators, and of many other observers is diametrically opposed to the independence of the luminosity and color sensations, which Dr. Edridge-Green asserts without proof. Dr. Watson was able to disprove the statement on one of Edridge-Green's own cases. For reasons which are fully explained by the Young-Helmholtz theory, the relationship between color perception and brightness perception is more easily demonstrated in the socalled "red blind group"; but with suitably delicate methods, it is equally demonstrated to be true of the more common "green blind" variety and the socalled "anomalous trichromats". Dr. Edridge-Green has never brought forward any experimental evidence to disprove these results; and until he does so, no unbiassed critic will be impressed by his ipse dixit. (Parsons)

Evolution of Color Sense. Edridge-Green's views are based on (1) Psychophysical theory; (2) Color vision in primitive races (Trans. Ophth. Soc., U. K. v. 31, 1901. p. 182); (3) The order of disappearance of colors in the spectrum as the intensity is gradually diminished (Edridge-Green's "Physiology of vision" p. 169); (4) The atavistic theory of color blindness. Psycho-physical Theory.

Edridge-Green declares there can be no doubt that an evolution of the color sense has taken place, but Parsons maintains that such a theory of the evolution of color sense, as the author advances, appears to be so extremely speculative as to be of little practical value. In the first place it would apply equally to the auditory sense, and it is well known that all attempts to bring the theory of color vision into line with that of hearing have failed (Helmholtz, "Physiologische Optik" 3rd. Ed. Vol. II, p. 97).

Second, the "waves which produce their maximum effect upon the sensitive protoplasm" are unknown, for it is obviously a specific stimulus, and if any conjecture is made on this basis the most probable waves would be in the yellow, which are of maximum luminosity.

Third, presuming that the sequence was as described, why did yellow precede blue, and why do not orange and indigo appear simultaneously.

Dr. Edridge-Green is strongly of the opinion that red and violet were the first colors seen, and that dichromics see only red and violet (pp 192-195 Ph. V). It is certain, however, that extreme cases of color blindness, if they limit themselves to two color names only, which is uncommon, almost invariably speak of blue and yellow. Even normal people generally describe the whole of the blue violet end of the spectrum as "blue." It is highly improbable that people would call one of the earliest developed colors violet, since this color is almost unknown in nature. Moreover, there is a considerable amount of other evidence in favor of blue and yellow as opposed to red and violet.

Color Vision in Primitive Races. This evidence is derived from two sources philologic and anthropologic. Parsons has reviewed the literature in his "Introduction to the Study of Color Vision," (p. 145), and in his opinion such sources as evidence of evolution produced results which are probably valueless. It is unlikely that any material change in the evolution of the color sense has occurred within historic times. That evolution in color terminology has occurred is undoubted, just as the finer shades of meaning of all kinds are progressively reflected in the vocabularies of advancing peoples. Even, however, at the present time, ordinary people, and often educated people, call a greenish blue either green or blue indiscriminately, and orange red or yellow. Of course, this indefiniteness is largely due to carelessness, but it is also fostered by varieties of illumination. Very little importance from the point of view of color vision is to be attached to crudities of this kind. In both cases he regards the evidence as inconclusive. That relating to the color vision of animals is very contradictory, and in any case does not support Edridge-Green's theory. That relating to the development of the color sense in the child is valuless for the purpose under consideration.

As to the order of disappearance of color in the spectrum as the intensity is gradually diminished, Edridge-Green says that they disappear "one by one in the reverse order of the development." This statement is not in accordance with the observations of chromatic thresholds, by Charpentier and others, particularly the very accurate investigations of Abney and Festing, and Abney and Watson. Burch has proved the variability of these phenomena according to the condition of the retina owing to previous stimulation.

In presenting the atavistic theory of color blindness, Edridge-Green's speculations lend little support to any theory of color vision. Since, however, the Young-Helmholtz theory is directly based upon the fundamental assumption which Dr. Edridge-Green makes, viz., the interpretation of color sensations in terms of physical stimuli, it is not improbable, on that assumption, that color defects interpreted in terms of Young-Helmholtz theory afford some evidence as to the evolution of the color sense, for, it is not improbable that a congenital defect of this nature is atavistic.

Sherrington remarks that "As regards color blind individuals, the author holds that their main types represent arrests of the above color evolution's course at one or other of its 6 stages. But as to this, ontogenetic and phylogenetic studies lend little support to it, or indeed, control for it."

Simultaneous Contrast, After Image and Successive Contrast. The phenomena of after images and color contrast are well known to have been difficult of explanation by Young's theory, and the efforts of Helmholtz to account for them have never been regarded as satisfactory. Hering's theory offered more plausible explanations but failed to account for more phenomena of color vision than it explained. In 1901, Mc Dougall showed that the facts of after images, and so-called "induction," could be fully explained in consequence with Young's theory. It has generally been held that the complementary (contrast) color seen in simultaneous contrast experiments is a purely subjective phenomenon. The Rollet-McDougall explanation is based upon the fact that the white light by which the contrast surface is seen contains light of all wave lengths, and therefore includes those wave lengths which give rise to the "induced" color. Hence the contrast color is present objectively, and requires no purely psychologic explanation. Dr. **Edridge-Green** also adopts McDougall's explanation of the color "induced" upon a grey surface, viz., that it is due to the inhibition or subtraction of the inducing color from the grey.

With regard to successive contrast **Parsons** notes that Dr. Edridge-Green still lays great stress upon his experiments with Professor A. W. Porter, in spite of the fact that their fallacies have been exposed by Burch. In his "Physiology of Vision" Dr. Edridge-Green says; "The greatest precautions were taken to prevent the admixture of stray light in those experiments which were of a crucial character," but, Parsons states that in the original papers they speak of stray light. Burch declared that the phenomenon could well be explained when the stray light was taken into account and they agree perfectly with Young's theory and Burch tells further that in his paper "On the Relations of Artificial Color Blindness to Successive Contrast" his results were different from Porter's and Edridge-Green's, yet were in all respects quite in accordance with the theory expounded by Thomas Young.

The chapter "On Simultaneous Color Contrast" is mainly devoted to controverting Hering's view of induction. The point taken is one established by MacDougall, tho the chapter makes no mention of MacDougall's work (1901) nor of Rollet's, which MacDougall showed (1867) to have recognized the same datum; namely that the objective white light by which the "induced surface is seen, inasmuch as it is white light containing all wave lengths, includes within it those of the induced color." MacDougall's view is also followed in regarding the warping of the physical grey's effect as being due to homonymous subtraction by the inducing color. Edridge-Green insists that his theory is totally different from that of Rollet, with which he does not agree, neither can it be explained by the Young theory.

VARIETIES OF COLOR BLINDNESS. Edridge-Green has divided cases of color blindness into two classes according as the defect is one of light perception, or one of color perception or differentiation without any defect in light perception; both defects may be present in the same individual. He cites five varieties of defective light perception, and classifies the varieties of defective color perception according to the color names employed. And in a single group of color blind, he cites numerous defects and degrees of errors.

In conclusion, **Parsons** voices what nearly all who are not expert special students must cry out after reading "The Physiology of Vision": "If all these statements are valid, we may well despair of arriving at any concordant classification of the anomalies of color vision; their discrimination must be purely empirical and open to innumerable fallacies. No single theory can cover so many complex variables, and investigation is reduced to the mere cataloging of observations by empirical methods. Such collections of facts are but the raw material for the devising of theories." And, Parsons does not hesitate to characterize the author's methods and say that it is a misuse of terms to call an inchoate collection of facts a "theory"; but it is only by adopting this solecism that Edridge-Green can substantiate his oft repeated statement that he has never yet discovered a fact which is not explained by his "theory," tho he has made diligent search. Professor Starling, indeed, seems to realize this aspect of Dr. Edridge-Green's work. In the 1912 Edition of his "Principles of Human Physiology" Starling wrote, "It is very difficult, however, to harmonize the facts of color blindness with either this (the Young-Helmholtz) or Hering's hypothesis. It is better to abandon hypotheses altogether and to adopt a purely empirical classification of color vision as has been done by Edridge-Green."

Fortunately, tho color vision is indeed a difficult subject, certain groups of facts are concordant in pointing to a hidden orderliness in the midst of the apparent chaos. Such, for example, are the facts of color mixture and the facts which demonstrate some definite relationship between color and luminosity. These, are the best established correlations in the whole field of color vision, and those the importance of which Dr. Edridge-Green minimizes or denies. And as Sherrington avers: "If tenets inculcated by the author rather than his observations, as supplied by his text, predominate in his review of the book the reason is partly that the text at times leaves some important item doubtful, e. g. p. 78, 'the subtended angle.' But verbal descriptions of visual experiments are difficult to give and may tax even the most skilled writers."

Parsons has attempted to show that many of Edridge-Green's statements rest upon doubtful foundations, stress has been laid upon the evidence against them because he has tacitly ignored it. Exhaustive study, few have the time or opportunity, or it may be feared, the inclination, to pursue; so that it is not easily that a sound judgment of the intricacies of the subject can be arrived at.

Edridge-Green regards the theory of vision as a very difficult subject and many scientific men hesitate to form an opinion because they do not know what can be said on the other side. The attacks on his theory while they might prejudice those only partially acquainted with the subject, greatly strengthen his position when it can be shown that the arguments, many very old, are mostly based on misstatements. He believes that his critics, particularly Parsons, have not read his book very carefully as nearly all the points raised have been answered there.

Edridge-Green states that in numerous demonstrations before the Physiological Society and the Physiological Institute, no one failed to see the Purkinje Phenomenon with the fovea, yet Mr. Parsons will not observe the facts for himself, neither has he attended the demonstrations nor has he accepted invitations to visit the author's laboratory. In conclusion Edridge-Green quotes from a letter, under date of March 1920, from Prof. Asher of Bern, to whom he had applied for an opinion on the theory of vision, deeming him to be the best qualified man in Europe:—"Your theory as to rods and cones, and their position in a photochemical theory seems to me very suggestive. I have always found a great difficulty in reconciling the facts of parallelism between the physical properties of the visual purple and the vision during dark adaptation with the physiologic and psychologic improbability of the Parinaud-Kries theory. Your views seem in a way to avoid the difficulties."

THE YOUNG-HELMHOLTZ THEORY. In the Bowman Lecture for 1917, **Berry** discussed the question of color vision, but without reference to hypotheses or theories. In his present paper he calls attention to what to his mind is the weak point of the Young-Helmholtz theory.

He would ascribe to the retinal rods an end organ function in connection with neutral noncolored light impressions, and to the cones, a similar end organ function, but in addition a functional relationship to qualitative light or color sensations; a function truly antagonistic. Whether the antagonism takes place in the end organs or in the visual centers, is one of the unsolved puzzles in optics. While we talk of one color destroying another, all color impressions when superimposed destroy each other in some degree, slight in those which are nearly alike to complete destruction in those which are dissimilar to the extent of being complementary; these latter are often referred to as "antagonistic," the full extent of which is noticeable when the colors are of equal "strength."

The problem of explaining color vision is one that has attracted both the physiologist and the mathematician. It is rare that a mathematician has sufficient knowledge of physiology to appreciate the difficulties and it is equally uncommon to find a physiologist to whom the subject is interesting and who is able to understand the mathematician's point of view. Thomas Young was a mathematician, and physiologist. His theory was not appreciated until it was taken up by Helmholtz, who was both physiologist and mathematician.

The great mathematic development of the color problem by Helmholtz and his pupils hardly seems necessary, because this problem is really a physiologic one. Much of the confusion that exists comes from the uncertainty as to whether color perception is retinal or central in origin. An attempt to explain at the same time both colorless and colored impressions by the interaction of the same postulated variables, is inconsistent with what is known of the physiology and pathology of color vision. Newton originated the idea of the complete causative interdependence of the two kinds of sensation, "and he suggested that the impingement of light on the retina sets up vibrations of different sizes, which run along the optic nerve fibers to the sensorium, causing different color sensations according to their size; "while a confusion of all caused white," a proposition inconsistent with what is now known of specific nerve energy.

Nevertheless, it was in keeping with his suggestion that Young propounded the view that each sensitive filament of the nerve may consist of three portions, one for each principal color. Helmholtz retained this conception of Newton's as an essential part of the hypothesis known as the Young-Helmholtz theory. Helmholtz, however, modified the hypothesis in so much that while the three receptors were retained, their nature was not predicated as qualified by distinct nerve fibers, three different chemical or electrical changes, etc. In this general sense the hypothesis lends itself to mathematical treatment and becomes more elastic, an elasticity by which can be explained and correlated abnormal conditions of the color sense and other phenomena with normal color vision.

Physiologically, the impressions of black and white are similar to those occasioned by the color series, for their sensations are as definite as those of red or blue or any other color; and they are also complementary or antagonistic to each other, and they can be subjectively intensified. "White" is a relative sensation, for, by simple experimentation a surface white or devoid of color can be made to appear of a still purer white. So also can black be made more intense.

The simultaneous effect of objective conditions, capable separately of giving rise to two equally strong and exactly complementary impressions, is to cause a colorless impression. So too an absolute black and an absolute white tend to neutralize each other resulting in a grey. The analogy between the colorless and the colored series of light impressions is very close. And yet there are marked differences. In the black-white series there is darkness at one end and greater and greater light at the other. In the two color series there is light at each end.

There can be no color without light, tho there may be light without color. The neutral zone which is uncolored is, as far as the light goes, brighter than would be the impression provided by one of the lights alone. Thus there is a summation of the two lights and at the same time a destruction of the color of each. There is, therefore, presumably end organ stimulation at both ends of the series. Combinations of any two colors produce an intermediate color whose brightness is the sum of that of the components. Abney has shown that "within the limits of error of observation, the luminosity of the combined spectrum, measured as white, is equal to the luminosity of spectrum colors measured separately."

The black-white grey, tho psychically the same as that resulting from combining two equally strong complementary colors, has a different relation to that of its components. The concomitance of the two conditions which would cause the two sensations black and white, results in a sensation which differs from either, but yet is one which for varying proportional activities of its two components has always the same character. How is the neutral effect of simultaneously superimposed stimuli, which, separately would cause impressions of two complementary colors, or of many colors, to be explained? Since Newton's time it has been inferred that they make white noncolored, light sensations. We now believe that the stimuli to color impressions destroy each other and "leave" white. How far antagonism may take place in the end organ response to simultaneous stimuli, for it is a physiologic process, is not known.

Berry regards as a main difficulty in accepting the Young-Helmholtz theory, this assumption that stimuli which when acting alone, would cause the sensation of color, may when combined "make" white. He calls attention to some of the differences between neutral and colored sensations: That a physical stimulus, when insufficiently strong instead of giving rise to a sensation of color, produces a neutral sensation; that when the light is dim, colors are unrecognizable, and only the white-black series of impressions are elicited.

There is an interval between the general (light) and the specific (color) thresholds for all colors; and this interval varies with different parts of the spectrum. It varies too according as the color is seen in the periphery of the retina or by the center, being barely perceptible for the fovea. It varies with the state of the retinal adaptation. And the relative brightness of the spectral hues varies with the absolute illumination. When the stimulus is too intense, the color impression is lost. All colors tend towards white when light is intense.

Neutral light perception exists equally all over the retina, being dependent upon changes which occur by the action of light on the pigment cells. Color perception varies both qualitatively and quantitively for different parts of the retina. Pathologic conditions show independence between the neutral light sense and the color sense.

These, and other facts, appear to indicate that there is some sort of differentiated origin for the two series of sensations. As the same light stimulus originates only noncolor impressions when acting thru the rods; but both color and noncolor impressions for cone excitation, from which the resulting sensations are always mixed, the independence of the two sensations is limited.

It does not follow that because the same energy provides the physical stimulus for eliciting both neutral and colored visual sensations, the one is strictly dependent upon the other, altho the effects of both responses to the stimulation are, physiologically, inseparably associated in the final character of the sensation. In addition to color hue, there is always some admixture of uncolored light sensation; yet in the case of the spectrum colors it is difficult to detect the prism of an uncolored element. It is this element to which the name "white valency" has been applied, which accounts for luminosity apart from color saturation.

The spectrum does not reveal all the pure color sensations which we normally receive, and our idea of primary or fundamental color sensation cannot be based on the colors found in the spectrum, for it most certainly must be a purely physiologic one.

There has been much speculation as to the 3 hues to be selected as fundamental. The selection has always been made on the assumption that our response to all compound color stimuli must be the "making" of white. One is almost forced to admit, from the known facts of color mixture, that separate receptors of some nature exist, but in connection with quantitative light sensations alone. It is likewise easy to imagine a system of a limited number of fundamental sensations which would suffice to explain symbolically both normal and abnormal color vision, excluding, however, the "making" of white light.

In the Young-Helmholtz theory the condition of the peripheral color vision is explained in a way which is inconsistent with facts. In the periphery of the normal field, there is no difference in kind between the noncolored impressions and those on direct fixation. Nor is there any qualitative difference in the two cases for certain hues of blue and yellow, altho reds and green appear at the periphery of a dirty yellowish or dirty bluish hue or altogether uncolored, according to the other hue impression that they produce when seen directly. As the black-white perceptions are unimpaired, so also are the combinations with blue and yellow. Thus, a yellow brown and a light blue are not materially altered on peripheral fixation.

If the power of correctly perceiving any hue is lost, that of perceiving the complement to that hue must also be wanting. If this were not so, then a white object would change in the impression to which it gives rise when passing from the center to the periphery of the field of vision, or vice versa. Possessing the power of perceiving color, we should at once notice if the peripheral impression were a colored and not an uncolored one.

There is no radical difference between normal peripheral color blindness and congenital color blindness. If by the Young-Helmholtz theory in explaining congenital color blindness one assumes the white of the color blind differs from normal white, the theory becomes untenable, unless by advancing the same idea as to the making of white.

If we infer that color vision is induced by excitation of different end organs or different elements of the same end organs, or different central connections some of the preliminary difficulties in understanding the color sense are overcome. The physiologic analogy between colorless and colored sensations lies mainly in the manner of their central production.

White light is associated with every color sensation and with the difference in the general and the specifically chromatic thresholds; and when the difference in retinal distribution of the means whereby colorless and colored impressions is evoked; all seem to point to a separate or differentiated origin of the two series of sensations. An additional reason for drawing the same inference is the absence of purely light-sense defects in congenital dichromatic vision. Still another is the retention of normal color vision, in some of the pathologic conditions in which the light sense is impaired.

To Berry, it may seem that the whole idea of a limited number of primary color sensations is wrong. He holds, that no one can say of any color that it is more primary than are the hues in its immediate neighborhood in the spectrum. To his own sensations, orange is not a mixture of red and yellow, but on the contrary it is a distinct color entity.

While the energies which separately would evoke complementary color sensations, or more color sensations; when simultaneously active and superimposed, these leave rather than "make" white; and this does not exclude the conception of three fundamental receptors for qualitative impressions alone. With such a modification, the mystery still remains unsolved by the Young-Helmholtz theory. It is likely that separate receptors of some nature exist in connection with qualitative light sensations alone, but why only three terminals? Obviously the same combinations could be made with four selected primaries as with three. As the whole matter is conjectural, there can be no convincing argument adducted in favor of only three. Yet even Hering's theory, which postulates four socalled primary colors, derives the whole gamut of colored and uncolored impressions from the stimulation of three specialized receptors, i. e. of three substances each capable of katabolic, anabolic changes.

It is easier, when we exclude the necessity for considering the white elements of every color impression, to account, by a threefold stimulation in varying degree and combinations, for the complete qualitative series of impressions, which it is possible to receive. With this limitation, it is no longer necessary to represent graphically these impressions as points on a curve, of the form given by Helmholtz. We might represent them by a circle, that is to say, so far as color hue sensations go we can begin with one color and pass on thru others till we come to the first again. And this relationship and order of arrangement, Berry repeats, is one of which every individual possessed of normal color sense is more or less entirely unconscious. This arrangement of the 150 or so hues, which may be distinguished in the spectrum, is physiologic and not physical, and must be according to hue and not to wave length. The rate at which perceptible changes in hue take place for different wave-lengths varies within wide limits.

Comparison of Color Theories. **Houston** offers a restatement and amplification of his theory of color vision. He bases his theory upon the idea that monochromatic light, falling upon the retina, gives rise to a nerve current, representative not of the frequency of this light alone in the spectrum, but, and to a lesser degree, of similar frequencies on either side of it; a result of the irregularities of molecular response in the photochemical process. The overlapping of such distribution curves for monochromatic red and green is thus able to produce practically the same distribution curve as that given by monochromatic yellow. A sufficient separation of two overlapping distributions will produce two maxima with an accompanying effect of complex sensation, such as purple. The position of the summit of the curve, therefore, is representative of the hue, while its breadth stands for lack of saturation or resemblance to white. An important feature of this paper is a detailed analysis of the color sensation curves of Maxwell, Abney, and Koenig and Dieterici, which for comparison are reduced as far as possible to the same units. The data of Dieterici are adopted as most representative of the normal and a plot of these on rectangular coordinates is employed as a basis for developing equations for the trichromatic color system, which are correlated with theoretic equations derived from the writer's hypotheses.

Troland has analyzed the various theories advanced to solve the basis of color vision; but the second chapter of his paper is not available.

Schjelderup critically reviews the principal theories of color vision and emphasizes the weak points of each. The "Young-Helmholtz Theory" labors under the fundamental difficulty of postulating the sensation of gray and white thru simultaneous excitation of red, green, and violet components. As a matter of fact there is no similarity nor relationship existing between white and red and green, or white with red, green and blue (violet). For such characteristic difference of mixed color effects the Young-Helmholtz theory offers no explanation. Moreover, the sensations of dichromates do not correspond to the requirements of the theory; but, in the case of protanopes and deuteranopes, yellow and green come out instead of the required green and violet or red and violet. The explanation of the color blindness of the eccentric portions of the retina offers further difficulties, as do also the phenomena of alteration.

The attempts of Leber and Fick, Ebbinghaus, Schenck, Ladd-Franklin, to modify the Helmholtz theory, remove a portion of the difficulties but give rise to additional objections. Upon the other hand convincing objections can be brought also against "Hering's Theory;" which fails to explain adequately the differences between the two types of red green blindness. Moreover cases occur in which only a single, (Schumann) or three, principal colors are absent, and these it does not explain; and also certain phenomena of alteration. G. E. Müller's attempted modification of Hering's theory is especially noteworthy; this author distinguishes between photochemic processes in the retina and the resulting stimulation of the optic nerve; between outer (retinal) and inner (nervous) excitability. The antagonism of complementary colors is found in the photochemic retinal processes; outer excitability can only fail in pairs. Thus the two types of red green blindness are readily explicable, but not so the conjoined failure of red green and blue yellow, in the periphery of the retina, and other phenomena as well. Kries has attempted in his "Zone Theory" to combine the fundamental ideas of the Helmholtz and Hering Theories, applying it to the peripheral portions of the organ of vision; while that of Hering applies to the centers.

The opinion that it is impossible to coordinate all the clinical data as to the organ of vision as a whole by any single view now extant appears to be gaining ground. The question then arises as to how many different stages must be set up to enable one to arrive at a satisfactory theory; Kries distinguishes peripheral and central processes, while Müller the retinal and nervous components. It is only possible to arrive at a satisfactory view by assuming three stages.

In the final part of his work the author develops his *"three stage theory."* He distinguishes these three stages as they occur in the visual center of the cortex, in the visual tract between these and the retina (intermediary processes) and finally the photochemic reactions in the retina. The question arises which of these stages is the basis of complementary colors? According to Hering's theory the antagonism is corrected with the psychophysic processes in the visual center: and yet Hering himself distinctly states that the whole nervous mechanism of sight, inclusive of the retina, participates in the psychophysic excitations.

The author assumes that in the cortical center of vision six independent physiologic processes occur as the fundamental bases of color perception, these are not united in pairs and are therefore capable of being separately defective, as in the case described by Shumann in which the perception of green alone is absent. The antagonism of the complementary colors depends upon the intermediary processes, as suggested also by researches upon localization of contrast. In this region the antagonistic colors may be absent in pairs; for example, red green blindness of deuteropes or yellow blue blindness of the type of Hering's cases.

The intermediate processes are brought about upon their part by photochemic changes in the retina. The latter may be considered to be composed of three components according to Kries-Helmholtz, tho there is no reason why there should be only two types of red green blindness, as also the same number of yellow blue blindness. Schjeldrup assumes concerning the photochemic processes of the retina, that in the retinal cones are three different photochemic substances, of which one excites the sensation of white in the nervous (subcortical) intermediate process, and the other two respond respectively to two different photochemic processes, in that they are photochemically reduced by light of definite wave length while they are oxidized by light of some other wave length.

Kappers' paper treats of the nature of the color process.

Becke has been engaged for forty years investigating the nature of color and of color perception. He has solved for himself the problem and he believes that in the visual purple lies the seat of the transformation of light into heat, that the heat thus produced is perceived as brightness and that all color perception is brought about by the mental reaction to the heat stimuli. The details of his researches are to be published by the Research Institute for the Textile Industries in Vienna.

Barton and **Browning**, have investigated the probable mechanism of the Young-Helmholtz theory, mathematically and with the aid of models. Three resonators of appropriate natural vibration periods were subjected to forced oscillation, and their respective amplitudes of response were recorded photographically. The natural periods corresponded to 760, 550, and 400$\mu\mu$ respectively; and the mathematic analysis showed that to produce the resonance curves required by the facts of color vision, the vibrations must be very highly damped, the damping being so great that persistence of vision could not be explained as a result of the continued action of the vibrators after the removal of the stimulus. The theoretic resonance curves differed from those demanded by the facts in not having zero values for any wave length, and in that the red sensation curve showed no second maximum in the violet. The ratios of the responses of the three model vibrators to different impressed frequencies were found experimentally to correlate remarkably well with many facts of color vision, such as the results of mixing various parts of the spectrum, etc. **Pötzl** writes in much detail on the central processes connected with color perception.

Bard propounds the idea that the retinal rods and cones, because of their length, in the direction of propagation of light, are able to record directly our impression of the depth dimension of visual space, the retinal image being in his opinion, not a surface but a solid. Both rods and cones are supposed to be specifically sensitive to all of the colors, because the limits of form and of color perceptions are the same. The pigment cells, lying alongside the rods and cones, serve to record the focus of the image within these receptor cells. The visual purple is regarded as the essential factor in color perception.

RETINAL RESPONSE, ADAPTATION AND FATIGUE. **Sheard** comments upon some recent conclusions regarding retinal characteristics, especially concerning light sense and adaptation. It is well known that electrical changes go on in the eye when the retina is exposed to light. In recent years experiments were undertaken to observe the effects of various colors upon this retinal response. It was found that relatively positive and negative potentials were established by different wave lengths and that the excessive action of a given monochromatic radiation would promote the subsequent action of its complementary.

With a specially devised "flicker" apparatus connected with a spectrometer and apparatus with which to fatigue the eye, **Allen** made a series of "persistency curves" after resting the eye in a dimly lighted "dark room"; in total darkness; after blindfolding; and in diffused daylight. The durations of color impressions were greater in the first three cases than for daylight adaptation, the greatest difference being obtained when the eye was rested in partial darkness. This is probably due to the fatiguing of the retina by the effort to distinguish dimly illuminated objects. It was once believed that the normal retina was obtained only after resting in complete darkness, but more recent experiments, have changed this idea. Nevertheless, observers are not yet satisfied that the retina can be "normal" in diffused daylight. Allen thinks that the retina under direct light or darkness is in abnormal condition. The change in the sensitiveness for light, which is produced in a retina placed in the dark, is not equal for rays of different refrangibility.

The adaptation of the retina in the darkness is not sudden, but progressive. The brightest point of the spectrum is not fixed, but varies in position with the brightness, changing from yellow to green as the spectrum becomes lowered in intensity. Below a certain intensity a change in luminosity does not affect the persistence of vision to any extent.

Allen's results as well as the bulk of the measurements described in the papers were obtained for the center of the retina.

In studying the development of fatigue when the retina was exposed to various colored lights obtained from the spectrum of an arc light, measurements of the persistence of vision were made after fatiguing intervals of one, two, three, five, and ten minutes, the maximum degree of fatigue was obtained in 3 minutes, which was 2 minutes less than the time required for darkness adaptation.

There is evidence to prove that the persistence of visual impressions on the retina is dependent only on the luminosity or brightness of the color, except for very low intensities. In a large series of records of curves, the elevations in all the curves occur in parts corresponding to the red, green and violet colors. Allen deduces from them that three and only three primary sensations exist, corresponding to these colors.

He applies his conclusions to the study of natural color blindness, and anticipates three types in which one sensation is missing; and three types in which two sensations are missing; of seven possible types of color blindness, in a study of 26 cases, he found 6, the only type not discovered being violet blindness.

His persistency curves for color blindness bore a remarkable resemblance to those obtained in the studies of retinal fatigue. Fatigue, therefore, might be considered as analogous to artificial or induced color blindness.

In their efforts to determine the relation between luminous sensation, "light," and radiant energy, that is to say, the relative visibility of radiation in different parts of the spectrum, investigators have encountered difficulties owing to the fact that relative brightness varies not only for different colors, but also thru changes in the size and the brightness of the illuminated field. And, the radiometric evaluation of the light stimulus has presented a still further difficulty. **Coblentz** and **Emerson** with the Bureau of Standards' complete equipment, undertook to correct the uncertainties in the radiometric measurements and to evaluate light stimuli radiometrically, as well as to obtain data on the relative sensibility of the eye to light of different colors.

A high grade spectrometer, giving no diffuse light, was used; and a cylindric acetylen lamp, the intensity of whose light is quite constant. The photometric measurements were made with the flicker photometer which could be adjusted also to make the equality of brightness measurements. It was found that little or no difficulty was experienced in making photometric comparisons with the flicker; but few observers were able to make accurate settings with the equality of brightness photometer, especially in the red and in the blue. In the yellow, about as many underestimated as overestimated the equality of brightness settings as compared with the flicker. In the less saturated colors of both the blue and the red ends of the visible spectrum, a greater number overestimated than underestimated their equality of brightness settings. The evidence from the data does not appear to be convincing, therefore, that the visibility curve, determined with the brightness photometer, differs from the curve obtained with the flicker photometer.

The total number of persons subjected to these tests was 130, of which seven were known to be color blind.

The investigation of subjects who were entirely lacking in color sensation is of interest in connection with the various theories of color vision. At low illumination only the rods are believed to respond to light, and no color is perceived. The maximum sensibility of the fovea of the normal eye lies between 0.49 and 0.53 for low illuminations. In total color blindness, the maximum visibility is in the region of 0.52. From this it would appear that color perception, in the case of so-called total color blindness, is similar to that of the normal foveal color vision under very low illumination and to that of rod vision, i. e. peripheral vision under high illumination.

In their study of the visibility curves of color blindness, Coblentz and Emerson found in red blindness the visibility curve abnormally high in the green; and, in green blindness, the sensibility is abnormally high in the red, but normal in the blue and below normal in the green. In a subject whose visibility curve was shifted toward the red, no trace of color blindness was shown in careful examination by the Holmgren test. In the color blind, the most common phase is a low visibility in the green. So, too, persons having normal vision may have a temporary depression of the visibility in this region of the spectrum.

The results of their investigations show that the effect of light upon the color sense is quite independent of its effect upon the brightness sense. An abnormal sense is associated with abnormal "brightness sensibility" visibility curve; but the converse is not true. They found examples of abnormal visibility curves in persons having normal judgments in sorting and matching colors. Red sensitiveness and blue sensitiveness cause small shifts of visibility curves bodily toward the red and the blue respectively. In the case of green sensitive subjects, the response to the red and the blue is not up to the normal eye. In the class of the red blue sensitive, a characteristic of infrequent occurrence, the visibility curve is very wide in comparison with the normal. In the case of subnormal blue or red sensitive persons, the visibility curve coincided with the average visibility curves thruout the spectrum, except in the blue violet and the orange red respectively.

The data available indicate that 60 per cent of the cases examined fall into 3 quite equally divided groups which are either 1, red sensitive; 2, blue sensitive; or 3 averaged. Similarly, 30 per cent of the cases are quite evenly divided into three groups which fall below the average sensibility in either 1, the red; 2, the blue; or 3, in both the red and the blue; thus giving rise to an apparently high sensibility in the green. One person in about 20 has a very wide visibility curve as compared with the average.

All tests made indicate that fatigue and the condition of adaptation of the eye have very small, if any effects. From the data obtained on 14 observers above 40 years of age, it appears that age has a perceptible effect upon the spectral visibility curve. The curves of no two persons appear alike, altho some are closely alike. The same visibility curves were obtained for the right and left eye of a given observer.

In discussing the comparison between the photosensitivity of the retina and the photoelectric properties of certain inorganic substances when exposed to light, **Coblentz** detects clues as to how the eye functions when exposed to light, and offers observations on the action of the eye as contrasted with instruments for perceiving and measuring thermal radiant energy. In other words, he treats the human eye and the photoelectric cell as radiometers. He assembles the results of his investigation of the action of the eye in response to light stimuli and inquires into the likelihood of there being anything in common with the photoelectric response obtained from inanimate material. He shows that when the eye is exposed to stimuli of radiant energy of different wave lengths, but of equal thermal value, the response is selective to the intensity as well as the wave length of the exciting radiation, that is, it is selective to light of different colors and intensities. The rate of response also is selective as to wave length, and when the response has attained a steady state, the maximum of the curve of the visibility of radiation or sensibility is found in the yellow green of the "visible spectrum." The response differs for different persons, some of whom are especially sensitive to blue, green or red; and persons who confuse colors, the partially color blind, have a distorted visibility curve. The curve of a totally color blind person is shifted to blue.

The photoelectric response depends upon the manner of applying the stimulus. In the gasionic photoelectric cell, when exposed to light, the response of the negative electrode is vaguely analogous to the retina; but the curve of the spectrophotoelectric response, or sensibility, has its maximum in the extreme violet in the zone in which the eye is quite insensitive to radiation. The shape of this sensibility curve, however, is very vaguely similar to the sensibility curve of the eye. The gasionic, photoelectric response is not selective to intensity; neither is the rate of response known to be selective as observed in the eye. The positive "after effect," which occurs after exposure similar to the persistence of vision, needs further and very careful investigation to make certain that there is such an effect. The spectrosensibility of solids is, like the eye, selective as to wave lengths and intensity; but the maximum response to radiation stimuli occurs usually in the extreme red or even far out into the infrared, and there is no similarity in the curve when compared to the curve of visibility of radiation of the eye. The response in molybdenite is positive or negative in the visible spectrum, and the rate of response to the stimulus is selective or nonselective, depending upon the voltage applied.

When the gasionic spectrophotoelectric response is combined with that of solids the composite effect is not analogous to the selectivity of the eye, in either the rate of response or in the intensity, nor in the wave length of the exciting light; neither does persistence of vision, color of after images, etc., which obtain in the eye, have a counterpart in photoelectric sensibility.

In the author's opinion, the evidence is not sufficient to demonstrate that there is a connection between the phenomena of color perception and brightness perception, and the phenomena of photoelectric sensibility of inanimate material. He concludes that the eye cannot be used to measure directly the intensity of radiation. It can, however, equate the intensities of two lights of the same color, and it can roughly guess as to the equality in intensity of two sources of light differing in color. And, considered as a whole, the sensitivity of solids is only vaguely, if at all, similar to the visual response.

Blondel describes a system of physical photometry similar to, but the "inverse" of, that used by Ives. He employes a spectroscope with a template in the plane of one of the slits representing the visibility curve and a thermopile to measure the intensity of the combined rays.

Ives offers a specification of a standard photometric scale in the field of photometry analogous to the thermometric scale employed in pyrometry. The specification of all the factors involved is based upon the most recent data of the author and of other investigators, and includes besides standards of color and of luminous intensity; the brightness and size of field, with the mechanical equivalent of light; the visibility curve; the flicker photometer and the method of choosing observers based upon specified test filters.

Allen reports the results of a continuation of his earlier studies on the effect of differential color fatigue upon critical flicker frequencies. The eye was first fatigued for three minutes with selected monochromatic radiation; after which, in separate experiments, the critical flicker frequencies for this and other spectral wavelengths were determined so that curves representing the spectral distribution of these frequencies after fatigue by different monochromatic stimuli could be plotted. In general, fatigue lowers the critical frequency, but not equally for all colors, and certain fatiguing stimuli produce no effect upon the spectral curve. There are four points in the spectrum yielding such stimuli lying at 660, 570, 470, and 420 respectively. The effect of the fatigue by stimuli, lying between these points in the spectrum, may be either to decrease the critical flicker frequency in a single spectrum region or in two such regions, as the case may be. For example, fatigue with yellow, 577 to 651, causes a decrease in the frequency for red and also for green but little decrease of this yellow itself.

The spectral regions, from which fatiguing stimuli produce no effect upon the frequency curve, are regarded as fundamental transition points, and a comparison of these regions with the color sensation curves of Abney, and König and Dieterici reveals a close correspondence with the ends or intersections of the component color curves in question. Fatiguing stimuli, which produce only one depression in the frequency curve, are regarded as monosensational. His findings "appear absolutely to determine the number of fundamental color sensations." Data from color blind eyes corroborate these interpretations and substantiate the three color theory with its implication that yellow is a compound sensation.

Color possesses the three characteristics of hue, saturation, and brilliance. Hue and saturation are determined by the spectral distribution of the stimulus; brilliance, by the amount of the stimulus. The quality of a color is determined by the hue and the saturation taken together. The relative brilliance, or brightness, of colors due to heterogeneous stimuli is commonly indicated by the ratio of the integrals, or luminosity, of light with respect to wave length, and, while many different spectral distributions may excite colors of the same quality, the quality of a color is determined by the spectral distribution of light.

The general relations between colors due to heterogeneous stimuli and the spectral distributions of these stimuli have not been formulated heretofore. **Priest** has now such an accumulation of data with which he has found it possible to formulate one general condition, always satisfied by two different spectral distributions exciting the same color. Six pairs of Bittinger's camouflage paint colors, including two greens, two blues, a reddish purple and a brown were employed. The colors excited by the sunlight reflected by the two members of each pairs were perfectly matched, or nearly so, notwithstanding the dissimilarity of the spectral reflections of the two matched members. Additional data was compiled from the use of the leucoscope and from the Arons' chromoscope. The data derived are most diverse, "yet from the table presented, the author would deduce the following rule:

"If any two lights, however different in spectral distribution, excite colors of the same quality, the wave lengths of the centers of gravity of their spectral distributions are coincident." By monochromatic analysis, that is, the finding by trial, a particular type of spectral distribution, which will excite color of the same quality as another distribution; the tables show that equality of the values of different distributions, which excite colors of the same quality, is confirmed to within the reliability of the data.

Lights of different colors may exert antagonistic influences. In a discussion of the history and theory of the electric action of light, on the retina, **Sheard** and **McPeek** report extremely interesting measurements on the "rest" and "action" currents of the dog's eye. The eyes used were always freshly enucleated and care taken to rest the preparations between exposures to the different colors. Spectral stimuli and a very reliable and delicate galvanometric system were employed. Constant stimulation produced fluctuations in the nerve current of about 12 seconds' period, combined with a progressive change in the potential of the nerve stump with respect to the cornea. This change consisted in an increase in the positive potential of the nerve for the warm colors of the spectrum and a decrease for the cold colors, the turning point lying at about 600$\mu\mu$. In the case of yellow, 590 $\mu\mu$, a conflict of these two opposing tendencies was observed. Complementaries tended to reverse or to neutralize the potential changes produced by each other. When a given potential level was established by a certain color, its complementary produced the greatest obtainable departure from this level. A plat of the potential conditions produced by the different wave lengths showed in certain of its characteristics, a striking similarity to the classical Hering color curves. The fluctuations in potential observed were not explicable on the basis of any external causes, but might possibly have been related to the fatigue, or after image oscillation processes of the eye.

Podesta has described the fundamentals of Ostwald's color theory in relation to the laws of color harmony, according to which color may be said to possess a threefold property, tone, white content, and black content. In order to measure colors practically, Ostwald has arranged these constituents into a century of well defined steps. The color world can be represented as a double cone whose apices are occupied by black and white, while the pure colors are placed at the bases. Regular lines or sections thru the color bodies or points will have a definite relation to one another and tend to assume a harmony of effect. **Jaensch** and **Müller** have written a lengthy paper on the perception of color brightness and color contrasts.

Priest believes that any discussion of complementary hues should be in terms of "frequency" rather than of "wave length"; for, wave length, at best, is an arbitrary reference scale, while it reasonably may be that some relation exists between retinal response and the frequency of the stimulus. In this brief paper, he shows a method of symplifying the relation between the frequencies of complementary hues, therewith suggesting the relations between the retinal response and frequency.

He calls attention to observations which in their results suggest that visibility is a function of frequency; and he trusts that by the correlation of these functions, new insight may be gained into the various phenomena of color and thus elucidate the nature of the retinal response and its relation to the stimulus.

Gutmann details the duration of the after images in the different color sensations. **Garten** describes the color mixture apparatus which Hering perfected and used from 1884 to 1914, in his study of spectral lights.

Measurements, made by **Hyde, Forsythe** and **Cady,** show that a close color match is actually obtainable between the acetylen flame and a black body, at a temperature of 2360° K., altho they could not obtain by Coblentz's distribution curve an accuracy greater than 7 to 8 per cent.

Practically all measurements of the visibility curve have been made with the acetylen flame. **Coblentz** points out that only very low precision of measurement is obtainable in the blue and violet end of the spectrum, and he offers a table of revised values.

Viewed as an optical instrument, despite the simplicity of its mechanism, the lack of achromatism is one of the chief errors inherent in the eye. This lack can be easily demonstrated according to **Sheard.** In viewing the spectrum in the spectroscope, we find that red and violet cannot be focussed at the same time. The eye piece must be adjusted and the spectroscope must be pushed further away when we wish to focus violet than when we try to see red clearly; and so will it be found when we attempt to study the other colors together. So also, if a simple lens is taken and the image of an object illuminated by a continuous spectrumed source is formed, the image will be found to have a red, blue or purple fringe. This is due to the difference in refractive index of the medium for rays of different wave lengths. Since the refractive index is greater for rays of short wave length, the blue rays will be deviated or bent more than the yellow rays and these in turn more than the red rays.

The eye naturally focusses for the brightest rays; in ordinary light, these are the yellow or yellow green rays. Hence the blue and red rays will be out of focus with the result that the image of a point will be surrounded by a purple fringe. When the spectrum is projected on a screen, if the red end is clearly visible, the violet end appears blurred and irregular.

The emmetropic eye appears to focus principally for the green or yellowish green region; for when letters in blue and in red are looked at from a distance, neither is seen clearly. But if a weak concave glass is placed before the eye by which the eye becomes hyperopic, the blues will become distinct; and on making the eye myopic by the addition of a convex glass, the reds appear distinctly. The hyperope will read the blue letters better because the blue and violet rays, being most refracted, give the clearest images. In the myopic the reverse is true. A normal sighted person is myopic in violet light, so that clearly seen distant objects become clouded when illuminated by blue violet lights.

In his entertaining paper on certain optical imperfections of the eye, **Sewall** refers to the simultaneous color contrasts obtained entirely subjectively by the passage of light thru the sclerotic, a phenomenon explained by Brücke about eighty years ago, but to which no attention has been paid. The light which has passed thru the semiopaque walls of the eyeball can no longer form definite images but is tolerably equally diffused over the retinal surface. The light on passing thru the choroid is no longer white but rosy. This red light stimulates and fatigues the red elements of its retina, so that when an image of a white object is thrown by light entering the pupil upon the background of the eye, it excites with preponderance the resting green elements of the retina and appears green. This phenomenon causes the author to inquire what might be the physiologic effects of light entering the eyes by ways other than the pupillary openings. He suggests that some cases of color blindness might be due in part to unusual transparency of the coats of the eye. If such be the case, he says, we might expect to find color blind railway employes, very differently sensitive by day and by night to the two classes of signals used.

Transmission and Diffusion. Brudenell Carter's observations on the phenomena of colored rings, surrounding a concentrated bright source of light, were reviewed in the Year Book for 1918. With Carter's Conclusions, **Sheard** does not agree; but offers, from careful study of his own case the following solution; 1. The universality of colored rings and coronae surrounding luminous sources under fairly favorable conditions of observation. 2. These rings are due to the diffraction of light by the constituent parts of one (or more) of the ocular media. 3. The results of experimentation based on the theory of diffraction of circular particles, or disks, when compared with anatomic data indicate that the first ring (commonly the only one seen) is due to diffraction by the cells of the anterior epithelial layer of the cornea, or possibly by the endothelium of Descemet's membrane. 4. The second ring is evidently due to diffraction by particles of a smaller size than those which produce the first ring. The writer suggests the inner layers of the anterior epithelial portion of the cornea. This ring has been attributed by Druault to the lens fibers, but reasons are advanced indicating that such a view is not probable. 5. The ciliary corona is without doubt due to the lens fibers, and the striae to the lens star.

In reviewing the subject of erythropsia, or red vision, in which everything is more or less of a ruddy tinge, Sheard refers to the observations of Fuchs, Widmark, Charcot, Schulek, Birch-Hirshfeld, Vogt, Birch, and Weydler. The condition is a temporary phenomenon rather than a persistent pathologic state. The tint of the coloration and the period of its manifestation are not definite. The cases may be clinically divided into three classes; those associated with over exposure to light, parent pathologic conditions; 2. those due to traumatism in which the media is infiltrated with blood; and 3. those associated with over-exposure to light, which are by far the greatest number. It was held as probable, that those depending upon exposure were affected by ultraviolet radiations, but more recently this has been denied. The latest views ascribe it to the red phase of the negative after image following over exposure to light, especially brilliant white.

Such photoerythropsia is a consequence of so unequal a fatiguing of the primary color sensations as to leave, for a greater or lesser period of time thereafter, a strong red phase of the after image, or a color sensation predominantly red. It has long been known that if any of the primary color sensations are fatigued those of the remaining color or colors become the predominant tints seen. Red has been found to regain its sensibility first, green next, and blue last. Red vision is to be expected after fatigue of all three sensations, since red recovers first; and, in the condition that the green and the blue are more fatigued than the red, the latter will be the more notably predominant. Red vision commonly occuring when the eyes are exposed to the radiations from snow on a bright day is due to fatigue of all color sensations, under the stimulus of the excessive quantity of radiant energy reaching the retina, with the result that the red regains its sensibility first. In all probability, the red vision after cataract extraction depends upon fatigue, the previous clouding of the lens having shielded the retina from excess of blue and violet.

Utterback's investigation covered a study of the transmission of light of different wave lengths thru fog. Measurements were made in thick, medium and slight fogs. The apparatus consisted of a tube with suitable optical end pieces, so arranged and connected with an air pump and a reservoir of capacity sufficient for rapid expansion, with the result that cooling would produce a fog. The intensity of the beam, entering the chamber, was measured both before and after the fog with a Macbeth illuminometer. The wave length ranges were obtained by means of absorption curves. The ratio of the illumination, in foot candles, with no fog, to the illumination with fog, gives the percentage transmission; an accuracy of observation of approximately one per cent is claimed.

The experimental results show that the transmission is highest for wave lengths from about 530$\mu\mu$ to about 590$\mu\mu$, and that it falls off very rapidly toward the red but not so rapidly toward the blue. The mean wave length for maximum transmission thru fog, is found to be at about 562$\mu\mu$. Singularly enough, Evan's investigations on the transmission of colored lights thru pure water (Proc. Royal Soc. London, vol. 57, pp. 117-162, 1894), are quite similar to those here reported. The maximum transmission for pure water is displaced toward the violet with respect to the maximum transmission thru fog, as found by Utterback. He concludes that any light will have its maximum transmission thru fog if the light is composed of wave lengths from 530 to 590$\mu\mu$ t. m. only.

According to **Rich's** observations, in the moonlight, the reactions to colors exhibited a nearly complete reversal of the usual Purkinje phenomen in twilight, for, only a limited range of colors was visible; orange, brown, and red, while blue appeared black. Some, but not all, greens were seen faintly; while yellows and violets could not be seen.

COLORIMETERY. In a lengthy paper, detailing the studies which have been made to obtain quantitative results in the responses of the retina to light radiations, **Nutting** treats of the reaction in color sensitivity. The retina is sensitive not only to differences in brightness; but to differences in the quality of that brightness, due essentially to the composition of the radiant energy reaching it. The differences in quality of the radiant energy are those of wave length or wave frequency. Color discrimination depends upon the ability to distinguish between lights of different dominant wave lengths. The sensitivity to differences in wave lengths can be readily determined and integrated into scales of tint or shade.

Separate colors may be specified by the coordinates, 1. wave length 2. intensity, represented in the case of self luminous bodies by emmissivity. Colorimeters, or color analyzers, make analyses in terms of pure hue and saturation. Absolute analyses are difficult to make; therefore comparators are used to determine matches between the unknown color and a prepared standard color, which may be a colored solution, various mixtures of pigments, or of quartz between crossed nicols.

Sensibility to differences in wavelength can be determined by the spectrometer. The variation of color sensation with wave length is not uniform. In the blue green and yellow regions, in the spectrum, the hue changes rapidly with wave length, while in the middle of green and red the change is very slow. Between these two regions all sorts of variations occur. Hue sensibility is taken as the reciprocal of the just noticeable difference in wave length. Hue sensibility over a wide range is independent of intensity. The monochromatic colorimeter determines color in terms of wave length of dominant hues and percent impurity; the trichromatic determines the ratios of three primary hues which, when mixed, will just match the known sample.

Employing spectral stimuli, **Allen** presents new data bearing on the relation between critical flicker frequency and stimulus intensity; and his results confirm those of Haycraft, who found the critical frequency to be proportional to the logarithm of brightness with a shift in the constants of the equation at intensities, corresponding with the threshold of cone vision. The relation of the results to the Purkinje effect is carefully considered by him.

Weve pursued a comparative study of the relation between the length of the light wave and the reaction to light in man, animals, and plants. A comparison of the curve of the distribution of energy with the curve of sensation for light, for a normal photopic eye in the spectrum of a gas flame, showed that the retina elaborates only a part of the radiant energy, which is determined by the wave length.

The periphery of the retina in man is insensible to color, and the light sensibility curve resembles that of the central part of the retina; and is identical with that of the color blind, except for a slight displacement to the side of the long waves. Those with a color sense probably possess a double organ, one sensible to light and color and the other presenting the curve of the color blind which functions only during dark adaption. The latter type of curve, being general thruout the animal world, and parallel with that of the plant and the photographic plate, suggests the idea that the disturbance of equilibrium, produced by the light in a chemical reaction, is the mechanism by which living matter transforms physical energy into the energy of sensation.

A study of the pupil reflex in a variety of animals, determined by a differential pupilloscope, showed that from echinoderm to insect and crustacean, the light sensibility curve resembled that of the congenital color blind and was parallel with the curves of the plant and the photographic plate, although displaced to the side of the long wave. In a study of the phototropic reactions of the seedlings of Lepidum Sativa, germinated in the dark and then exposed from two to five hours in a special apparatus described in the text, to the different spectral colors and to the corresponding tint of grey, it was seen that the curves of sensibility to light were absolutely parallel with that of the photographic plates.

COLOR SENSE IN LOWER ANIMALS. In the case of two fishes and a frog, **Arey** found that the retinal rods remained in a shortened condition, until a sufficient intensity of illumination was reached to enable one to read ordinary print; while the cones remained elongated until colors could be distinguished. While others have expressed doubt on the point, in this investigator's opinion, the thresholds for these responses correspond with the utilitarian demands of the functions which they have been supposed to subserve.

According to **Hess,** the optic organs of fishes and of many invertebrates are totally color blind and behave like the dark adapted human eye. The reaction of ants and Daphnids to ultraviolet light is explained by fluorescence.

Minnich found that light stimulated the honey bee to active movement, the workers having a strong positive phototropism. When one eye was blackened the insects moved in a loop in the direction of the functioning eye, the "circus movements" varying with the intensity of the light. The constancy of the circus movements, Minnich believes, shows that the arthropod eye is stimulated continuously by light, and does not require intermittent illumination.

Hess' observations on the question of the color sense in bees, were noticed in the Year Book for 1920. Vol. 16. pt. 3. p. 233.

In a series of experiments to test the chromatic vision of wasps, **Wager** used lumps of sugar on pieces of colored paper; and from his results, he believes that these insects are attracted by color and can appreciate color contrasts.

Etringham, having in mind the sensibility of animals to colors and their appreciation of distances, and paying particular attention to the nature of the image formed by the compound eye of insects, contests the view of Hess that insects are color blind. In his studies of the vision of butterflies he found that objects were distinguished at distances from 3 centimeters to 1 meter from the eye.

The studies of Hess in the color sense of birds has been reviewed; and, his findings, concerning the shortening of the violet end of the visible spectrum in day birds, are confirmed by **Henning**. The significance of the presence of red oil globules in the retinas of the sauropsida is that objects are more distinctly visible when seen thru a mist if seen by red light, hence distant vision is improved. In the day birds the red globules act as filters. The characteristics of the tortoise's eye with its round pupil receive particular mention. It is especially adapted for very distant vision in misty air, while for near vision under water the eyes are as serviceable as in air. The tortoise's retina with its red globules and cones, but no rods, no visual purple, nor tapetum, is analogous to the yellow spot of the human eye.

Schnurmann carried out a series of observations on the changes in color sense of fishes in proximity to colored and colorless backgrounds. The reactions noted only confirm the supposition already now well received that the reactions of fishes are like those of the totally color blind man.

COLOR FIELDS. Because of the difficulty experienced by laboratory and clinic workers of getting reproducible results in determinations of the color sensitivity of the peripheral retina, **Ferree** and **Rand** undertook a study of the limits of color sensitivity with the hope that their results might be of service in comparing the sensitivities of portions of the peripheral retina to different colors, from a theoretic point, as well as in relation to the diagnosis of various ocular diseases which cause abnormalities in the relative distribution of sensitivity to the different colors. Their apparatus consisted of a spectroscope designed to give high intensities of light in varying degrees and with this they investigated the extension of the limits, and the variations in the zones, and the determination of the limits with all the lights made equal in energy to the blue of the prismatic spectrum employed.

In summarizing the results of their findings in a number of observers, they state that the far periphery of the retina was not blind, but only deficient in sensitivity to red, blue, and yellow; that is, with stimuli of sufficient intensity the limits of red, blue, and yellow coincided with the limits of white light vision. For their observers, the blindness to green was absolute. To produce a detectable change in the apparent limits of sensitivity in the most remote parts of the retina, the amount of change of intensity required was very great. As might be expected from the regularity in the distribution of sensitivity in the peripheral retina, the amount changed very irregularly from center to periphery of the retina in a given meridian and from meridian to meridian.

They mention two other important phenomena resulting from this irregularity; (a) the shape of the zone of sensitivity to a given color changed with the intensity of the stimulus employed in making the determination; and, (b) when stimuli of equal or of the same order of intensity were used, the limits for red, yellow and blue were found to interlace irregularly rather than to coincide in complementary pairs, as was reported by Bull, Hegg, Hess, and Baird, in a more limited investigation of the retina's powers of response. The former phenomenon is the direct corollary of the difference in the rate of decrease of sensitivity to a given color in passing from the center to the periphery of the retina in the different meridians; the latter to the change in the ratio of sensitivity to the different colors from meridian to meridian. The lack of uniformity of grading from point to point in the periphery of the retina, while striking, can scarcely be considered as surprising. It is in fact just what might be expected of those parts of a sensitive organ which are little used and poorly developed.

The responsibility of the accepted clinic rating of limits, in the order from widest to narrowest, of blue, red, and green, doubtless for the greater part rests with the relative insensibility of the pigment stimuli used in the work of the clinic. With stimuli of like intensity, the limits for red, yellow, and blue, coincided with the limits of white light vision; for stimuli of lower intensities, taken from the prismatic spectrum, they were rather widely concentric; and for stimuli of equal energies of the order of intensity represented by the pigment stimuli, they were interlacing.

The interlacing of limits for red and blue was a normal result for stimuli of equal energy of medium intensities. It might not, therefore, be due to pathologic disturbances in the distribution of sensitivities, as has been claimed by certain clinicians. In all responsible work on the determination of the apparent limits, it is obviously of great importance to bear in mind that the results are dependent both upon the actual disturbance of sensitivity and the numerous factors which affect the apparent powers of response of the peripheral retina.

The problem of artificial daylight is one of much importance in many industries. It is difficult to define daylight on account of its great variability; yet, according to the *Brit. Jour. Ophthal,* it is essential that a standard of "normal" daylight should be defined; and the degree of accuracy, into which "artificial daylight" unites for various purposes, should approach the specified standard. The Sheringham daylight apparatus, consisting of carefully combined color reflectors, is one of the recent inventions devised in attempts to solve the problem. It was devised by a physicist, an artist, and a camouflage expert, and is described in the Illuminating Engineer for February, 1920. In commenting on the device, the editor points out the necessity for a standard white surface and a standard nomenclature of color tints, for which the list prepared by the Societé des Chrysanthemistes in France might serve as a basis. In a communication from the United States by M. Luckiesh, it was brought out that artificial daylight is extensively used there, the sources of light described by him are tungsten (Mazda C) lamps equipped with colored glass filters.

Perhaps the greatest difficulty in all color studies is concerned with the illumination. **Rich** has found that the "daylight" lamp (Mazda C 2) is so unlike actual daylight as to unfit it for use in color matching in research pursuits, altho it is satisfactory for laboratory uses in demonstrating the laws of color mixture. In the artificial light, the marked deficiency in blue as compared with daylight becomes apparent when colors in the short wave end of the spectrum are combined with others.

Ferree and **Rand** have devised an apparatus by which illumination can be accurately graduated to any desired intensity for any length of time, to be adapted to the test objects already accepted in clinical practice.

Juhász has studied the appearance of the complementary after image, using in his experiments prolonged colored stimuli. He learned that the latent period, after which the complementary after image appears, is independent of the intensity of the original image, altho clearness and durability of the after image increased with the intensity of the original stimulus. Shorter latent periods and longer persistence of the after image result when a pale colored object is shown on black than when shown on a white back ground, and the converse is true for a dark color. When the period of fixation exceeds a certain threshold value, the complementary image appears after a relatively lengthy latent period without being preceded by a positive after image and a dark interval. As the fixation period is prolonged beyond this threshold time, the latent period for the after image diminishes until a constant value of about twelve seconds is reached. When the luminosity of the colorless field, gray white, on which the complementary image is seen is increased, the latent period and the persistence of the after image are reduced, and the paler is the color. The converse is true when the field is darkened. The color of the after image is affected in the same way when projected on a white surface, as in the corresponding color sensation, by subjective addition of white. In order for a complementary after image to be recognizable, the colored surface must exceed a certain size. Latency, clearness and duration of the after image increase with the increasing size of the original image.

Treutler has described the weakness of color vision coming on after more or less exhausting night service. Several years ago, H. Schulz published his observations on the action of small doses of digitalis on color vision, from which he was led to believe that the drug markedly affected that sense. **Bohnenberger** has recently critically tested Schulz's results, but he could not detect any changes in the color perception of his subjects.

Beri-beri being of common occurrence in Japan, amblyopia is frequently complained of. **Itch** has studied the disturbances of color sense observed during the amblyopia, and such as he found accompanying retinitis centralis. Central scotoma is the common symptom. In studying the color defects, he used a color (preisel) on the basis of the George Young's Threshold test. He found in the amblyopia of the beriberi that green is affected first, while in central retinitis, yellow is the earliest destroyed.

STANDARD COLORS. **Munsell** has specified and classified colors for the purpose of art, in which he has adopted the natural and logical method of color classification already held by Bezold, Rood, Abney, Nutting, and others. In this method, a color is specified completely by the three characteristics: 1. the characteristic by virtue of which it may be referred to the spectral colors—the hue. 2. The characteristic in which colors vary from gray to colors having a pronounced hue purity, saturation, or chroma. 3. The characteristic by which grays may be arranged in series between white and black—*brightness, luminosity, value.*

Munsell's system has been in use for several years by ink manufacturers and has, therefore, demonstrated its practical value. **Priest, Gibson** and **McNichols,** the analysts who have here studied the system, deem it faulty from the point of view of precise colorimetry, because of its lack of fundamental accurate specification. This paper is a partial report of their efforts to establish a fundamental standardization from an examination of a set of cards furnished by the Munsell Color Co. In an effort to interpret their report, the analysts accepted the theory that light is a radiant power which, impinging on the retina, excites the sensation called color; that this radiance travels between the light source and the retina in the form of a vibration; and that if this vibration has some one definite frequency, the color produced will have a pronounced hue, as red, orange, yellow, green, blue, or violet, depending upon the frequency. The color will also be very saturated, that is, of high chroma. If the energy is distributed among many vibrations of different frequencies, the color will be recognized as white or gray and will have no distinguishing hue. If the energy is distributed among few vibrations of different frequencies it may produce any of a vast number of colors of various hues and chromas, depending upon the relative amount of energy of different frequencies.

In their discussion of the Munsell value scale, the analysts studied the diffuse spectral reflection of a series of neutral grays, reds, yellows, green, blues, and purple. They recommend certain improvements of the system and seek to establish it upon a more secure foundation. Their results are of prime importance as regards the basis of the system and point toward an accurate standardization. They present a series of curves of spectral reflection, indicating the comparison between the energy of various wave lengths required to produce various colors and the value of the selections from the Munsell cards. The apparatus employed consisted of the Koenig-Martens spectrophotometer, and the Gibson electrophotometer. The results, which they obtained, show conclusively that the statements in the Atlas as to the reflection value numbers are in error, and that the Munsell value numbers have no directly proportional relation to the reflections. But the analysts used the noonday sunlight as an illuminant, while Munsell's results were based on the use of the Munsell photometer. His apparatus was less perfect and less exact than others which have been devised since his death. It is likely that he adopted his scale from artistic considerations and really approximated to the true natural scale of value by calculations all his own. Their observations upon the reflections for the different hues, however, verify in a remarkable manner the consistency of Munsell's values.

The analysts would urge the establishment of a standard system, in effect similar to the Munsell, and suggest the revision of that investigator's works based upon later computations. They suggest that the value scale should be one in which the reflection of the cards form a geometric series. Each color should be specified physically (a) by spectral reflection curves, (b) by monochromatic analysis on the basis of a to-be-established standard white, (c) by its constants under prescribed conditions on the Arons' chromoscope.

The colorimetric and photometric specifications of the cards should accompany the Atlas, and should refer in precise terms to the fundamental standards. Relative reflection or value measurements on different colors must be made with light of specified quality, preferably noon-day sunlight. And, in conclusion, a general agreement in the nomenclature of colorimetry among experts interested in this subject, such as that which is now being worked out by the Bureau of Standards, and the Optical Society of America.

Hess in his paper on the disturbance of color senses, has added a number of interesting illustrations. **Ando** has described an apparatus consisting of colored glasses with which to measure the color sense. **Vierling** has written on the examination of the color blind; and **Hegner** and **Seimeini**, on the anomalies and disturbances of the color sense.

The phenomena of simultaneous contrast, as viewed by the Helmholtz school, depend upon errors of judgment and only in a minor degree upon differential effects on the central and peripheral retinal fields. **Hess** cannot support this view as the result of his experiments, in which he was able to show that a difference of luminosity of even 1 ; 800 could be effaced from two small adjacent fields by powerful illumination of the peripheral fields. The same result followed when the outer field was darkened; when the intensity of light in the peripheral field around a small colored area of moderately high saturation was diminished, the area appeared white. The idea that simultaneous contrast appears most distinctly on feeble illumination of the surroundings is not borne out, for Hess found that the contrast color gains in distinctness with an increase in the saturation of the stimulating color. He combats the Helmholtz view that stimulation is only slowly established or resolved; and, from observations on the Purkinje after image it was shown that this reaction is not to be regarded as a retarded effect on the rods. Moreover, that view is erroneous which holds that the image falls on the fovea in red light and under conditions of dark adaptation.

TESTS FOR COLOR BLINDNESS.—**Jennings** here gives an outline of the clinical manifestations of color blindness and describes the tests commonly employed; comprising the Holmgren worsted test and the modification presented in the Jennings self recording test; the Williams Lantern; Stilling's plates; and Nagel's cards and anomaloscope. The differentiation of color by means of the anomaloscope has been carefully detailed by **Köllner.**

Jennings has devised a lantern for the detection of color blindness, which he believes possesses the advantages which others do not, namely, it may be used in the lighted room but the examinee looks into darkness; the distance and size of the color openings are uniform; the operator is not required to make combinations of colored glasses, as one complete turn of the wheel, containing thirty-two colored lights, is sufficient for a searching test.

The lantern consists of a metal tube two feet long four inches wide and two inches high, blackened in the interior, and contains several diaphrams. It is mounted on an adjustable stand. The observer looks thru two eyepieces; at the far end of the tube is a revolving disc with the 0.75mm. openings in which are placed the various combinations of the standard colors. The source of light is an electric lamp. As each color is shown, its number and name appear at the opening in the disc. The operator can see to fill out his record as the examination proceeds. By means of a shutter in the tube, one eye can be tested at a time, and is therefore useful in simulated monocular blindness. The dot of colored light is seen at an unvarying distance and the detection of central scotomata is assured.

Hess examines his cases first with the tunnel method and determines the degree of red or green vision. He further determines the pupillomotor value of blue and red lights. The field is next taken with a constant red, a green, a blue, and a yellow; and the foveal color vision also is tested. The tunnel method gives the numerical expression for any departure from the normal in the sense of red green visibility, which the author qualifies by the term red green equality. For relative red vision =U, (inequality) 1, for relative green 1. U.=3.6, which corresponds to a high degree of vision for green. In the measurement of the fields he expresses the ratio to the normal; e. g., an object normally visible at 15° and at 10° for the person under examination is equivalent to 0.66 (As the author does not intend to examine the regional disturbances in the visual tract for the determination, the limits must be fixed in different meridians, the above ratio can be given, altho in reality the numbers apply to different regions of space).

In red green equality, he gives the ratio of green to red e. g. $Gr/R = 1.7/1.1 = 1.5$. A table is appended showing measurements in congenital disturbances of the color sense. In high degrees of green sight, the ratio of the limits of green to red may reach 2.7; in high degrees of red sight, it may equal 0.48. In general the departures of the red green limits are parallel to the degree of foveal red-green. In several cases of green sight, in some the limits for green were normal, for red contracted. In red sight, the writer found the limits for red normal, for green, contracted or normal, the former enlarged, or both limits decidedly contracted. The limits for blue and yellow were normal in the case of several affected with red and green sight. In one case of high degree of red sight, with very narrow limits for red and particularly for green, it was found that the narrow limits of the ratio for red green held not only for the eccentric portions but for the entire field.

For the determination of the foveal inequality various modifications of the test are given. Thus the occasional difficulty of those so affected to recognize bacilli stained red, is to be ascribed partly to the contrasted field for red and partly to lowered perception of the central portions of the retina. In eccentric portions of the retina the inequalities of two colors (e. g. red spot upon a grey field) soon became equal. In the defective, the middle portions of the retina behave like the excentric, as regards red green perception in the normal; they are identical with the so called early exhaustion. Among 8 green color blind, the writer found the limits for blue and yellow normal in 5. In 3 the limits lay further peripheral. 4 red blind showed contraction for yellow and blue; perception of blue yellow was lower also in the middle portions of the field. In conclusion, the writer insists that red green inequality must be sharply distinguished from a lowering of the ratio. Rayleigh's equation reveals only red green inequality; but it gives no clue to any diminution of the ratio, which may be present. Decided difference in this ratio can occur. The view generally held that all "anomalous trichromates" are also "weak in colors" (an expression best avoided) is accordingly false.

Ebbecke has written upon the relations existing between color blindness and the amblyopic border of the blind spot.

Engelking and **Eckstein** have been seeking to obtain absolute standards for colors to be used in perimetry. Blue, yellow, red and green, the four test colors, commonly present very different degrees of luminosity, which variation is likely to cause uncertainty in the estimation of the field of vision for colors, particularly in pathologic states. As the colors of the usual test objects are of unequal saturation, the authors have endeavored to obtain a standard of colors which would afford equal physiologic saturation, white value and periphery value. Clinical examinations being made usually in daylight, the eyes are therefore light adapted; the authors determined to make the objects "periphery equal"; and not "dusk equal". They employed rotating discs, containing a number of carefully selected colored discs in combination. The colors were copied by an artist from the patterns of the mixtures on the discs, and the authors are working on the reproduction of the colors for publication.

The unreliability of the usual method for practical testing of color blindness is universally recognized; this was again manifest lately in the railroad accident in Dresden, 1918; the engineer, tho affected with congenital red green blindness, passed the usual tests perfectly. The unreliability depends upon the variations in the physical conditions and the variability of the illumination under which the fixed color tests are seen; moreover the quantity of light impinging upon the percipient terminals in the retina, is different in different eyes or because of the coloration of the macula lens. Passing or failure to pass the tests is no certain sign of normal or abnormal color perception.

Exact results can be obtained only when the lights used in the examination are capable of such modification that the equations between variously colored lights can be maintained. For scientific experiments, this can be effected by means of spectral lights and with tops. **Hess** has devised a practical method for the clinical examination of the color sense by means of the "Goldberg wedge." Goldberg constructed, for photographic photometric purposes, gray wedges, consisting of thin layers of gelatine enclosed between two glass plates in wedge form, joined together at a very small angle. Any desired color may be taken instead of gray. With Hess' apparatus, the subject under examination sets up an equation between the variable gray of a plane surface and a hole in the center of the gray surface which is illuminated by particolored light. If a gray and a yellow wedge which are capable of sliding over one another, are used, every transition from blue thru green to yellow may be given the hole. The brightness of such blueish or yellowish green may be varied by a white plate which sends its light from beneath thru the color wedge. The apparatus also possesses a short tube thru which the observer looks down from above upon the gray surface.

For the diagnosis of red green blindness, the single equation between green and red suffices; but by the use of a red wedge an additional equation may be set up between red and gray; and with red in place of the gray surface, between red and green. Thus this simple apparatus may also serve for the examination of the individual differences of the color sense, for which purpose red is reflected laterally by means of a plate of glass upon the green coming from beneath thru the wedge. The ratio of green to red may be easily found, wherein the central hole appears gray and vanishes in the adjacent gray surface. With this arrangement, some persons, those relatively red or green sighted, will see the spot in the surface colored red or green. In the examination with the spectral apparatus, the relatively red sighted form the Rayleigh equation, like the "deuteranomalous," the green sighted like the "protanomalous." The quantity of red required may be measured exactly by a movable gray wedge.

The apparatus may be employed to determine the color field. Against any constant unchangeable color, the objection always holds that its unchangeableness fits only for a certain definite degree of illumination. The green test is furnished by means of the blue and yellow wedge, which without changing the color tone while looking peripherally, vanishes in the equally illuminated gray of the adjacent surface. The observation tube is turned aside; and the person under examination fixes a small mark which moves upon the gray surface, the latter being provided with a scale. A comparison with the normal eye is made each time. The author confines the determination of the limits to a single meridian. In cases of acquired disturbances of the color sense for general examination upon a larger gray surface, a suitable adaptation of the apparatus would be necessary. Examination of the central color vision can replace perimetric determinations in many cases, for which purpose, as for the examination of central scotomata, a wedge of green or other color is interposed only so far as to enable the person under examination to see a shade of green, as determined by a normal eye. With the use of a gray wedge, numerical examination of differences of perception as well as of hemeralopia can be carried out.

Hess describes, also, an apparatus for the examination of railway and marine workers, employing a variable spot of color. In a small chamber is attached a filter for red with a movable blue and yellow wedge and a gray wedge can be brought in front of each. A mixture can thus be made by means of a small mirror, which will furnish a gray, which may be changed to green or to red; and the brightness can also be modified. To the one wall of the chamber is attached a dull white surface with a central spot; opposite is a lamp to illuminate the central spot. The normal eye sees the entire field as uniform, while the anomalous one notices a red or green spot in the white surface. The examination may be made with artificial light or with daylight. The apparatus may be used for the determination of red green blindness, on excluding the red by turning the mirror. By varying the position of the blue and yellow wedge, that shade of green can be found which appears of the same color as the adjacent surface to the color blind.

The author describes an apparatus for measuring the disturbances of the color sense by a very simple "tunnel method," which he has found valuable. In a tunnel two meters in length, is placed a dull white Ritchie wedge, the left surface of which is illuminated by a movable ground glass light, while the right half receives light which has traversed a filter for red and a blue and yellow wedge. The intensity of red, required for the equation to be measured by the amount of displacement of the light source, furnishes a measure for the degree of the abnormality. This procedure has several advantages over the anomaloscope, especially in permitting variation of the red light without changing the intensity of the green.

Individuals who confuse red and green, who are really either red blind or green blind, when told to describe a pure prismatic or diffraction spectrum, do not state that the end occupied by colors of long wave length appears to them to be red (if green blind) or green (if red blind), as it might be supposed that they would, but on the contrary, both classes are unanimous in describing it as yellow. This has been held to constitute not only a powerful objection to Young's hypothesis but also to advance definite evidence in favor of Hering's views. In **Hartridge's** opinion, these facts, which have been held to discredit Young's hypothesis of color, are, however, completely consistent with it. On Young's hypothesis, a simple explanation can be advanced from the fact that both the red and the green blind call the less refrangible end (long wave length end) of the spectrum yellow, namely that they have found by experience that their long wave length sensation is most strongly aroused by objects which the normal sighted call yellow. This also explains why they call spectral and pigmentary greens dirty yellow, grey, or grey blue according to shade; also why they call white "white" and not purple, on the one hand (green blind); or blue "green," on the other (red blind).

Daltonism, in the opinion of **Polack** and **Longuet,** is the manifestation of trichromatism with a weakened perception of green. It should be sought for systematically, as it is of frequent occurrence. They regard Maxwell's color box as affording a more complete and a more accurate test than is possible with the Holmgren wools.

Hess describes in much detail the characteristics of "red green" blindness.

In the skein tests the dichromatic color blind select in ordinary illumination skeins similar to those picked out by the normal sighted in "minus red" light. According to **Gibson,** certain of the dyes employed to color wools are fluorescent, but the placing of a "minus red" filter between the eye and the wool skeins will produce exactly similar confusions to those manifested by the color blind. **Larsen** writes on the obligatory color tests of seamen and railroad men.

Color Psychology.—**Sheard** comments upon the recent experiments carried on by Pressey, of the Harvard Psychological Laboratory, to inquire into the influence of color upon mental and motor efficiency. Pressey's work consisted in studying the effects upon the mental activities, of single colors, spread uniformly over the visual surroundings of the subject. Primary red, green, and blue of equal saturation were used. The person, tested, sat at a table which was covered with white paper and flooded with light of the desired color thru the use of suitable screens. None of the tests involved visual tests such as visual acuity.

Because of chromatic aberration, we know that monochromatic light gives a better defined retinal image than does white light. Likewise, the eye is quite accurately corrected for achromatism at the mid region of the spectrum—the yellow, green or region of maximum visibility—and that it is very imperfect in this respect in the end regions, the red and blue. In practical lighting, we employ a white light source; one of wide spectral range; hence the acuity factor and any efficiency tests involving visual acts would demand the use of the yellow green. Luminous efficiency criteria demand similar conditions. The conclusion which the editor draws from Pressey's work is that the higher psychologic influence of color illumination is of very minor importance, yet it cannot but be admitted that the use of color in lighting has a practical influence upon human efficiency. The state of the nervous system and the conditions of fatigue and overwork may be important factors in any individual cases tested for the effect of color in human efficiency.

Jaensch and **Müller** have written an interesting paper on color psychology. In a lengthy but entertaining article, **Angelucci** traces the appearance of the *symbolic use of different colors* in patriotic literature and art, and attempts to show the far reaching effects of the different forms of light in the psychology of the races. As an instance of this, countries with a clear sunny climate produced an art in which an emphasis of form was noticeable; whereas in countries with misty climate, there was a lack of this emphasis of form, and colors became prominent, as in the Venetian and Flemish schools. He describes the experiments which prove heliotropism of the retinal epithelium in the lower animals. This greater response for blue, lesser for yellow and least of all for red is found, as the animal scale is ascended. The retina behaves in this way like the panchromatic plate in photography.

He propounds another theory as to color perception, not described in sufficient detail to be entirely clear. In substance, he interprets color sensation as due, first, to the freeing of negatively charged electrons in the retina by light falling upon it; and second, to the chemical disassociation of the retinal elements producing electrically charged "monads," to whose distribution is due the chemical and physical phenomena which result is in different color sensations.

Instances of *color audition* have already been published by him, and now in a personal communication, **Ribon** quotes the words of a blind man who declared that he perceives various colors when certain strains of music or other sounds are uttered. Ribon believes that there must be many such cases; and he, therefore, urges upon others that they report any cases in which has been observed a close connection between the psychoptic and the psychoauditory centers.

The first case of congenital color blindness noted in literature was reported by **Tuberville** in the Transactions of the Royal Society of London in August, 1684. The account is rather meagre and might not satisfy scientific observers today. The case is commented on by Hirschberg.

COLOR BLINDNESS IN WOMEN.—Medical literature has so far but rarely touched upon color blindness in females; indeed since the extensive statistics of 1870-1880, but little research work has been published concerning the color sense of woman. Since the spring of 1918, **Schiötz** undertook a series of investigations of school girls to compare the results obtained with those he had obtained in an earlier investigation of recruits, upon whom he had used the following tests: Stilling, Podestá, Nagel, Cohn, Helmholtz, and Daae. He had discovered, out of 332 recruits, 37, i. e. 11.2 per cent, were dichromatics or anomalous trichromatics.

The school girls numbered 1270; their ages ranged from 10-14 years. Upon these, he used Stilling's pseudoisochromatic tables, as the main test, and those of Podestá and Nagel for further tests. As many as possible of those showing a deficient color sense were tested with spectral color mixtures and Ishihara's tables, which are similar to Stilling's plates and very efficient. In the 1270, 11 were found to be so abnormal as to be declared to have deficient color sense. There were four dichromatics and seven anomalous trichromatics. In 12 doubtful cases selected by means of the spectral color mixtures, only one turned out to be deuteranomalous; and the 11 others presented normal equations. The apparatus used was a Schiötz's modification of a Tscherning model, which allowed a number of various color equations. Malling's equations were employed and Rayleigh's red green. Many others were tested with a blue green, and a white (of blue and yellow) and an endeavor was made to fix "the neutral point."

In 1919 he examined 930 girls at three private schools. This time he used Stilling's and Ishihara's tests; three were to a considerable degree red green blind, six to a lesser degree, and a number were doubtful. The two series included 2,200 with a total of 20= 0.91 per cent showing a deficient color sense, or, more specifically, seven deuteranopes and 13 deuteranomalous.

Schiötz regards these figures as too low, as a final value, yet not too low for a comparison with the results he obtained in an investigation of 2005 males in whom he found 10.7 per cent defective. He, therefore, assumes his results to be as comparatively indicative of the proportion for Norwegians, i. e. to 10 red green blind men there is one red green blind woman. Ten per cent of men and nearly one per cent of women are dichromatics or anomalous trichromatics. It is probable that similar figures would be found in other countries, if similar investigations with the same tests were carried out. In a study of the statistics of various observers, in a total 51,140 men, 2,013 were color blind or 3.94 per cent; 13,090 women, of whom 43 were color blind or 0.33 per cent that is to say there were nearly 12 times as many color blind men as women.

The observance of color blindness in Japanese school children has been noted by **Takeuchi.**

In **Schiötz's** investigations of color blind families, he aimed at finding the highest possible number of red green blind women, because in their families one would presumably find numerous red green blind persons. He has had the opportunity of examining 16 color blind women, dichromatics and anomalous trichromatics, their families and nearest relations. Together with the above mentioned 20 school girls, this will make 36 cases of color blind women. His lines of pedigrees are not yet complete; yet whenever he has been able to ascertain the facts, these color blind women had color blind fathers and color blind sons.

From his researches in medical literature, he concludes that the results published conform completely with the results of his own investigations, proving that congenital red green color blindness invariably and without exception follows the laws of inheritance as a recessive sex linked character. No single exceptions can be demonstrated to the unyielding principles, cases quoted as exceptions have proved to have been partly misquoted and partly to be concerned with anomalies other than congenital red green blindness.

Defects and Diseases of the Eyeball

HARRY S. GRADLE, M.D.

CHICAGO, ILL.

This section carries the literature from August, 1920 to July, 1921. For previous references see O. L., v. 16, 1920, p. 237.

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DIGEST OF THE LITERATURE

ANOPHTHALMOS. A case of bilateral anophthalmos in a child whose parents were first cousins was reported by **Triepel**.. Apart from the ocular condition, the child was well developed. The right eye proved to be an irregularly round mass, some 8.5 mm. in diameter. The cornea was differentiated, but the other ocular structures formed an indescriminate heterogeneous mass of tissue. The extrinsic musculature was well developed as were the other contents of the orbit. The left eye measured somewhat less than the right eye and was even less differentiated. Both optic nerves were almost thread like and showed no fiber differentiation. It proved to be very difficult to follow the optic tracts even as far as the chiasm.

McMillan saw anophthalmos and ocular maldevelopment in four cases in one family. Case I. Female aged 5 years. Right eye undeveloped. Cornea absent and eye blind. Left eye, apparently normal except for a coloboma of the iris downward and very poor vision. Case II. Male aged 3 years. Completely blind. Right eye undiscoverable and socket apparently empty. Left eye undeveloped and the cornea absent. Case III. Male 2 years. The right eye showed a small dark spot in the center of the front of the eyeball thru which light could be perceived. The left socket seemed to be empty. Case IV. Male aged 1 year. Right eye undeveloped with an opaque cornea and no light perception. The left eye seemed normal. **Fessler** has written on the development of the eye.

Congenital anophthalmos was observed by **Cecchetto** in two babies who were cousins. There was consanguinity in the family. The first case, six days old, showed normal lids, and small conjunctival sacs with no sign of a globe to be seen or felt on either side. Four years later a small bluish nodule was seen under the skin of the left lid. On removal this proved to be a heterogeneous mass of tissue with a few cells suggestive of retinal cells; and extending backward from the mass, was a strand of connective tissue, containing some pigment and considered by the author as an abortive optic nerve. The second child presented an identical picture and neither showed other abnormalities.

ANOPHTHALMOS AND CYCLOPIA. **Leplat** was able to produce either condition practically at will in tadpoles by the use of an aqueous solution of some toxic substance (chloral hydrat or ethyl alcohol) on the frog's egg during the process of embryonic evolution. Monstrosities of all types were obtained and tadpole embryos by the hundreds were studied. The type of monstrosity could be controlled to a certain extent according to the stage of development at which the toxic substance was applied. Apparently the action was merely an inhibition of differentiation and was not specific. If the inhibition occurred in the early stages of gastrulation, the encephalon remained rudimentary, the telencephalon and the diancephalon were not differentiated, and anophthalmos resulted. If the toxic substances were applied later, there was more or less marked confluence of the eyes, varying from complete cyclopia to normal. Based upon these experiments, the author elaborated a theory as to the causation of anophthalmos and cyclopia which involved a marked change in the modern concept of the rudimentary development of the eyes. The view had been elaborated by **Stockard** and is reviewed at length by **Hill** who described in detail a case of cyclopia. A comparative description of the whole fetus was accompanied by a histologic examination of the area in question. The theories, past and present of cyclopia, were reviewed and the bibliography of the subject brought down to date. A case of cyclopia and rhinocephalia was reported briefly by **Penichet** and **Avellan.** Cyclopia is also reported by **Thieke Best, Hagemeyer** and **Winkler.**

CRYPTOPHTHALMOS. In a boy of eight years and his sister of eleven years, a condition of cryptophthalmos was found by **Magruder.** The same condition existed in the mother. In each case, the eyelids were normal except for supernumerary eyebrows. No motion of the eyeball was demonstrable as the lids and the eye balls were not separated. The boy had light perception in both eyes, but the girl only in the left eye. In the discussion, Marbourg stated that he had attempted operation upon the mother and found that the eye lids were adherent to opaque corneal tissue.

CYCLOPIA IN DOUBLE MONSTERS. In the case reported by **Cosmettatos** there was fusion of the heads with three eyes; two lateral which were microphthalmic, and a median eye of similar size, which had a single cornea but two crystalline lenses, vitreous bodies, retinas and optic nerves. A diaphragm running from the corneal margin represented the fused scleras. The cornea appeared to belong to the right eye. The iris of the right eye was defective but of the left eye almost entirely lacking. The lens, vitreous and optic nerve of the right eye were also the better developed.

SYNOPHTHALMIA. **Villegas** reported a case of a male fetus, 359 mm. long. The palpebral orifice was wide open and the lids were not adherent. No pupillary membrane was present. There was only one orbit, apparently formed by the coalescing of both sides. It lay in the middle of the forehead and contained two rather prominent eyeballs which had fused. The lids were everted as in ectropion and there were no lacrimal puncta. Numerous anomalies were present elsewhere.

Oertel reports spontaneous luxation of the eyeball, in a negro about 25 years of age. She stated that on several occasions her eye had come out. It first occurred when she was stooping over to tie her shoe and she had to be very careful not to assume this position. There was no evidence of goiter, both eyes were prominent, vision 20/20 in each eye, movements normal and ophthalmoscopic examination negative. In preparing to take a picture Oertel retracted the lids and the globe immediately popped out. There was considerable blepharospasm, but the eye was easily replaced. The patient died shortly after, without known cause or previous recognized illness. The pathologic findings were negative except for a small tumor found in the cerebellum. This was benign in character, so its influence was entirely due to pressure.

EYES OF ANENCEPHALIC MONSTERS. Three cases of anencephalos studied by **Monbrun** presented the same defects of the eyeball. The globes were of normal size and seemed perfect, there being no colobomas of iris or choroid. The optic nerve entrance was absent being replaced by large excavations, and there were no nerve fibers in the optic nerve. The retina presented normal layers except that the ganglion cells and nerve fiber layer were entirely lacking.

PANOPHTHALMITIS. A case of panophthalmitis following puncture of the sclera and injection of Ringer's solution for detachment of the retina was reported by **Stargardt.** It was believed that the infection was due to imperfect sterilization of the solution injected. The exciting organism was found to be a Gramnegative micrococcus that did not correspond to any known organism. The cultural details of the organism were given by **Bach.** Seventy cases of panophthalmitis were studied in the Philippines by **Ubaldo.** Fifteen cases resulted from corneal ulcers due to plant leaves, ten cases from traumatism, ten cases from inflammatory conditions of old lesions, and thirty five were endogenous. Two fatal cases were among the list. The author prefers enucleation of the eye ball in the lighter infections and evisceration in the more septic type. Fifty of the cases were operated upon, twenty by enucleation and thirty by evisceration.

Three cases of metastatic ophthalmia were seen by **Goto**. The first was a tubecular suppuration of the choroid, the second was a cerebrospinal meningitis with suppuration of the eyes, and the third an ophthalmia caused by fungi. **Yokomazu** writes on the bacteria found in traumatic panophthalmitis.

Lindner reported the examination of an eye removed for metastatic ophthalmia 2 days before the death of a man suffering from septicemia from a war wound. The organism found was a streptococcus found in the vessels and masses in Schlemm's canal, and the angle of the anterior chamber. The iris was necrotic apparently from thromboses of the vessels.

ENUCLEATION OF EYEBALL. The technic of local anesthesia for enucleation as practiced in four cases was described by **Martin**. This is essentially the Siegrist method. The operation of enucleation and the substitutes for the classical method were considered at length by **Weeks, Greenwood,** and **Woodruff.** Each author gave his own personal views on the subject and described at length the wellknown and oft described methods of enucleation, both with and without implantation; and evisceration, with and without implantation. **Weigelin** writes on enucleation or exenteration after war injuries.

ORBITAL DEVELOPMENT FOLLOWING ENUCLEATION. At three years of age, the left eye of a girl was enucleated because of a penetrating injury. During subsequent life, she occasionally suffered intense orbital pain and during such an attack was seen by **Dickinson** 32 years after enucleation. He found that the upper lid was firmly adherent to the orbital conjunctiva so that the greatest possible palpebral aperture was less than 4 mm. Radiographs showed a marked contraction of the orbital cavity. It was believed that the pain was due to scar tissue traction on the supraorbital branch of the nerve.

EVISCERATION VERSUS ENUCLEATION. In considering this question, **Weidler** sent a questionnaire to more than one hundred of the leading American Opthalmologists and was able to classify the answers as follows:

Prefer enucleation 26; Prefer enucleation with implantation 12; Prefer evisceration, 5; Risk of meningitis, None seen, 18; Doubtful, 1; Slight, 14; Seen after enucleation, 4; Negligible, 4; Considerable, 1; Risk of sympathetic inflammation, None seen, 34; Slight, 3; Seen, 1; Possible, 3.

From the answers received he arrived at the conclusion that evisceration is of advantage, (1) in panophthalmitis, (2) for cosmetic reasons, (3) patients will often allow that operation and refuse enucleation; and (4) there is less apt to be secretion from the orbit. **Mahoney** wrote on the indications for evisceration.

IMPLANTATION OPERATIONS. **Poulard** inserted a hollow glass sphere within the eye ball in twenty cases within the last three years and it was retained in all but one. He made an incision thru the sclera, concentric to the limbus and about five millimeters removed. This was continued transversely toward the internal and external canthi, permitting a full view of the interior of the eyeball. After checking the hemorrhage that followed evisceration, the glass sphere was inserted. **Oehlecker** used a very similar technic but implanted a piece of live bone, preferably one of the small bones of the foot. It did not seem to make any difference whether an auto-or homoplastic bone implant was used. Twenty cases were operated in this manner and in a few, the bone sloughed out.

Weve operated on four cases by the operation method of Zeemann designed to facilitate wearing an artificial eye when the conjunctival sac is small or the lower lid missing. In 2 cases the conjunctival sac had been contracted for years. When the patient attempted to open the eyes a tense membrane was visible. No cul de sac existed and an artificial eye had never been worn. A skin bridge was cut where the fornix of the lower cul de sac should be. The lower incision divided only the epidermis, while the upper penetrated to the conjunctiva. The skin bridge was turned inside and served as a fornix. It was sutured to the conjunctiva destined for the surface of the lower lid. If not enough conjunctiva were present the surface of the wound had to be covered with Thiersch grafts. A small artificial eye was used as a prothesis, and the lids were temporarily sutured. For a few months small abscesses appeared at the line of incision. In future Weve would prevent the lower lid becoming too thick by a partial tersus extirpation.

Nishimura has written on the use of sponge and of animal tissues grafted into the orbit in preparation for prothesis. Stellario also writes on ocular protheses.

Concerning Ocular Protheses. Costal cartilage was used by **Esser** for nasoplasty, restoration of the zygoma, and reconstruction of missing portions of the orbit in several cases. It is claimed that this substance is more easily nourished than bone and consequently forms a better base for plastic work. For the purpose of raising the artificial eye in the presence of too great an upper orbital furrow, **Pichler** shortened the lower lid by a lateral tarsorraphy. This resulted in pressure upon the lower portion of the artificial eye and overcame the cosmetic defect. A similar result might be attained by a wedge shaped excision of the posterior lid plate (Kuhnt's ectropion operation) and even combined advantageously with a fat implantation. The terrific facial injuries of the late war frequently necessitated the use of ocular protheses of the molded type and **Weekers** described the paraffin moulding of such protheses, involving the eye, the lids, and surrounding facial tissue. The esthetic results were frequently very satisfactory. Equally satisfactory cosmetic results were obtained by **Oliver** and **Jackson** by the use of artificial eye and lids attached to spectacle frames. The care of an artificial eye was described at length by **Davidson.**

To remedy the slight ectropion of the lower lid which sometimes prevents the retention of a glass eye, **Snydacker** splits the upper lid at the temporal margin, making a slight circular flap following the line of the orbicularis. We thus get all the skin needed to correct the defects. Attached to the lower lid it holds it in place because the natural line of cicatrization extends up against the downward traction of ectropion.

Metabolism of the Human Eye. **Hamburger** described some further experiments with models to prove the watertight closure of the anterior chamber from the posterior chamber in support of his oft repeated theory regarding the nutrition of the anterior aspects of the eye. According to Hagen, after puncture, the anterior chamber refills and the eye remains soft, showing that the main supply of the aqueous must be from the eye ball itself, i. e. the vitreous, and not from the blood vessels. He considers that the important function, of the ciliary body is not secretion, but rather a cushion to withold the accommodative pressure from the iris. **Löwenstein** inclines toward this same view, basing his beliefs upon the results of his refractometric examinations. In five cases of complete atrophy of the optic nerve, the anterior chamber was punctured and the aqueous examined with the Abbe refractometer. The refraction was found to be about 20. The reformed aqueous was again obtained and examined in the same manner. It was found to be poor in albumin, in contradistinction to the reformed aqueous of rabbits. The results tended to support Hagen's theory as to the vitreous origin of the second aqueous and also explain the effect of anterior sclerotomy in increased tension secondary to iridocyclitis.

OPHTHALMIC CYTOLOGY. In the normal eye, **A. Fuchs** found plasma cells in large sizes behind the iris root and at the inner margin of the ciliary muscle. These cells were two to three times as large as the plasma cells found in the blood. In inflammatory conditions, particularly of the chronic type, these cells are markedly, but irregularly increased in numbers within the tissues of the eye ball. The author believes that the plasma cells originate from the endothelium of the small blood vessels without any transitional lymphocyte form.

RUPTURE OF THE EYEBALL. In a seventy year old man, an intense pain had been followed by a profuse hemorrhage thru a large tear in the cornea. **Terson** and **Goulfier** examined the case anatomically and found a massive retrochoroidal hemorrhage. Enucleation may sometimes be avoided by excision of the extruded tissue. **Parsons** reported a case of subconjunctival rupture of an eyeball with corrected vision of 6/18 some six months after the accident.

Spontaneous rupture of the eye ball may be due to a weak spot in the cornea (following ulcers, etc.) or to increased tension. The latter is the only true rupture and is very rare, according to **Terrien.** The various causes and types were discussed and a complete bibliography appended.

THIERSCH SKIN SHAVINGS. To obtain a perfect plane of the skin of the upper arm, the skin is stretched by one hand above, and below by a plate of metal 3 mm. thick, 10 cm. long, and 1.75 cm. wide which has a hook for the index finger and at the anterior edge a few small convex hooks. By the aid of this device, **Kuhnt** obtained shavings of skin of uniform thickness, cut with a planoconvex razor.

The Lacrimal Apparatus

M. Hayward Post, Jr., M.D., F.A.C.S.

ST. LOUIS, MO.

This section of the Digest carries the literature from July, 1920 to July, 1921. For previous references see O. L. v. 16, 1920, p. 218.

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DIGEST OF THE LITERATURE.

Anatomy. In order to determine the part of the nasal bony wall corresponding to the lacrimal sac, **Blumenthal** made measurements on 83 skulls. His conclusions follow. The fossa lacrimalis forms an elliptical surface with a long perpendicular and a short cross diameter. The former begins at the fronto-maxillary suture and ends under the transition of the fossa into the bony duct, being from 12 to 24 mm. long. The horizontal diameter is obtained by the sum of the cross diameters of the frontal process of the superior maxilla and the lacrimal bone, being 4.5 to 12 mm. The fossa may be high and deep or flat and deep with recesses above or below. The variability in the form of the lateral wall of the nose is considerable. The crista lacrimomaxillaris may be indistinct or even absent. The part of the frontal process from the apertura piriformis to the crista lacrimomaxillaris varies greatly in width, while the bone in front of and near the anterior insertion of the middle turbinate, at the agger nasi, varies in thickness. In some cases an ethmoid cell is found in this region and the middle turbinate may have a broad attachment to the lateral nasal wall.

Measurements of the nasal canal according to the race were made by **Santos Fernandez**. Fifteen white men and nine African negroes, one white woman and one African negro woman in all, were studied. He concludes that the nasal canal is longer and follows a more tortuous course in the white races. The nasal canal of the negro is wide and follows a straight course. To this fact he ascribes the greater frequency of dacryocystitis in the white race as compared to the mulattoes.

Van der Hoeve accepts the opinion of Ask that the canaliculi originate as shoots from the lacrimal sac altho the following case would seem to show that the canaliculi originate from the lid margins. A child on the left side of whose face the facial slit had remained partially open and produced a large coloboma of the lower lid, had the lower punctum situated to the temporal side of the coloboma. Both tear ducts were shown in a Roentgenograph after thorium injection with sounds in the upper and lower canaliculi.

Lamb, in an interesting survey of the recent work on the lacrimal apparatus gives a brief outline of the anatomy of the canaliculi, sacs, and ducts. The canaliculi are surrounded by a dense mass of muscular fibers. These are arranged circularly about the vertical portion and longitudinally with the horizontal section. The walls of the sac contain a great quantity of elastic fibers, whose physiologic action is described later. The duct has a length of 15 to 20 mm., and a bony diameter of from 3 to 8 mm., but this is filled by mucous membrane so as to leave merely a capillary slit. The narrowest portion of the duct is at its upper end where it joins the lacrimal sac, next in its middle portion, and thirdly at its opening into the nose, where it is constricted by the valve of Hasner.

An interesting description of a muscle, which extends from a fixed insertion in the skin of the upper lid to a mobile one at the crest of the lacrimal sac, is given in a very well illustrated article by **Stepleanu Horbatsky**. This muscle is as a rule a portion of the orbicularis superior, tho occasionally a distinct entity.

Physiology. **Hurst** has written on the lacrimal gland of the hedgehog.

Bourquin describes a case of loss of function of the lacrimal gland following paralysis of the oculomotor nerve and the superior branch of the facial. He takes the occasion for an interesting discussion of the origin of these secretory fibers. The muscle described by Stepleanu Horbatsky, according to his observations, has a definite physiologic action and plays a definite role in that by stretching the crest of the sac upwards, it causes the tears to be sucked into the sac thru the puncta. On its relaxation, it again allows collapse of the sac and the onward forcing of the tears thru the lacrimal ducts. **Lamb** ascribes the conduction of the tears into the sac to the contraction of the orbicularis muscle, which in winking pulls the outer wall of the sac outward and forward, after which the elastic fibers in the sac wall contract and force the tears into the duct which is wider than the canaliculus.

A very interesting study of the physiologic action of the lacrimal secretion and its bearing on some of the pathologic processes at work in the eye, has been made by **Charlton.** This secretion contains albumin in a strength of 5 to 1000 parts and globulin in an undetermined amount. He shows by experiment, that the protein will absorb aqueous solutions and salt solutions, swelling considerably in so doing. When salt is present, the absorption is slower and the globulin of the proteid is absorbed and some of the transparency of the latter is lost. He found, furthermore, that this absorption would take place thru various membranes, including the cornea. From this he concludes, that the aqueous is absorbed thru the cornea by the lacrimal fluid, whose globulin in turn is absorbed by the salt in solution giving the well known opalescent appearance to the tears. He suggests that glaucoma may be, in certain cases, due to the presence of albumin in the aqueous preventing absorption and transfusion, and suggests that the greenish color of the pupil in these cases is a further indication in support of this observation.

A woman of 54 seen by **Fuchs** had been troubled for 5 years with photophobia and great dryness of the eyes. For a year this had been worse and he had also noted dryness of the mouth, from lack of salivary secretion. No lesion of the lacrimal or salivary gland could be demonstrated. Pilocarpin hypodermically produced sweating but no increased secretion of these glands. The condition appeared to be one of atrophy without previous inflammation, or possibly a lesion of the sympathetic nerve.

To determine the resistance of the lacrimal canal **Sonnen** used an 0.08 thick and 0.05 cm. wide rubber tube, 1.7 mm. long, with a fine canula at one end, and at the other end a glass funnel. The entire tube is graduated in centimeters. The patient is seated at a low bench with the head back, the canula is passed into the lacrimal sac, an assistant raises the funnel, at a velocity of 25cm. a second, and the patient is to indicate when the water enters the mouth or nose. When this occurs the funnel is lowered until the patient no longer feels the water. This process is then repeated. The heights above the lacrimal canal to which the funnel has been raised are recorded with a subtraction of 5cm. for the resistance of the manometer. Eighteen normal lacrimal ducts in 12 persons were examined. The apices of the first measurement were all below 45cm. The second apex was as a rule lower than the first. Generally it was found to be zero, which shows that in certain cases it had a negative value. Thirty five cases of dacryocystitis were also examined, and all values for the apex were found from the upper limit of the normal to complete obstruction.

It was concluded that in normal conditions a pump mechanism overcomes a pressure of not more than 40cm., and in general a higher resistance provokes epiphora. An interesting discussion accompanies the paper. Sonnen agrees with Rochat (see v. 16. 1920 p. 242), that epiphora should not hastily be ascribed to a defective pump mechanism.

PATHOLOGY. In the study of a very large number of cases, where the lacrimal sac had been removed in the service of H. Truc, **Carrère** constantly found eosinophiles in the surrounding connective tissue. They were purely local. They were more numerous in the chronic than in the acute cases, and varied in number inversely with the number of polynuclear leucocytes. The cells themselves, were mononuclears with granules either heaped thick or scattered diffusely. He is of the opinion, that they originate from the blood stream and form a second line of defense. Their action against the bacteria is phagocytic.

ANOMALIES. **Coppez** reports a case of congenital epicanthus and bilateral ptosis. There was a small swelling in the region of the palpebral lacrimal gland but no gland tissue was present. There were no tears present normally nor even after inhalation of spirits of sal ammonia, nor after emotional states. Except however, for a slight sensation of dryness, the patient experienced no discomfort. The conjunctiva was normal, as was the secretion of the sputum. **Gerard** has described congenital ectopia of the lower lacrimal puncta.

A *cyst* of the anterior wall of the lacrimal sac was removed by **Kubik.** That there was no direct communication with the sac, was demonstrated by the fact that the cyst could not be evacuated while the sac could easily be irrigated. At the operation, a cyst full of serum was removed. Kubik concludes from his study of the literature on the origin of cysts of the lacrimal region, that they originate either in the glands of the wall of the tear sac and the diverticula formed by inflammatory processes; or from various anomalies in the structure of the lacrimal sac, such as remnants of embryonic conditions of development.

In two cases, **von Szily** made a diagnosis of *internal fistula* of the lacrimal sac by means of Roentgen rays. He injected first bismuth and later an impalpable oxid of thorium, titrated in liquid paraffin. In one case the outflow of the irrigation fluid could be directly observed. Without preceding phlegmon of the sac, a fistula had formed with astenosis at the place of predilection, opposite the middle turbinated body, thru which the irrigation fluid ran into the nose. He discusses in detail, the anatomic relations of the fossa lacrimalis to the lateral wall of the nose, and to the accessory sinuses and the pathogenesis of the fistula interna. Empyema of the ethmoid eroding the medial wall of the lacrimal sac, tubercular changes, inflammation within the sac, enlargement or diverticula of the sac, as well as spontaneous or congenital resorption, are suggested as the causative factors. Stenosis of the duct may be present but is not essential. Spontaneous healing of a dacryocystitis may follow the establishment of such a fistula. Treatment consists in the majority of cases, in extirpation of the lacrimal sac; and opening the ethmoid cells, where inflammation is present in them.

DACRYOADENITIS. In an unusually interesting paper entitled, "The Syndrome of Sclerosis of the Glands of the Face," **Portman** has given a very thoro study of *Mikulicz disease* and allied conditions. He begins with Mikulicz' classical description. Between twenty and thirty years of age, the lids begin to swell, because of which an oculist is consulted. Slowly the palpebral orifice closes and on palpation, an indolent hard tumor is found. There is no disturbance of the eyes nor external muscles. Or it may begin in the region of the parotid glands presenting a picture once seen never to be forgotten. There is swelling in the submaxillary region, the lids almost closed, swollen, shiny and tender. Opening the mouth, one sees hypertrophy of the sublingual and palatine glands, the glands of Nuhn-Blandin, and the salivary glands. The skin and mucous membrane are movable over the deeper glands and structures. They are tender on palpation but whether hard or soft the tumors never fluctuate. Because of insufficiency of salivary secretion and the swelling of the glands, there is dryness of the mouth and difficulty in swallowing. The vascular and lymphatic systems remain undisturbed.

The etiology is next discussed and in general he divides the opinions into two different groups, the one considering it a local infection, the other a general disease; aleucemic lymphadenitis, syphilis, or tuberculosis. He leans toward the opinion of the latter group and cites a number of cases where a generalized disturbance has been found. He bases the diagnosis on bilateral swelling of the salivary glands, with mild onset and no change in the blood or nerve cells. Only one or all sets of glands may be involved. Differential diagnosis is somewhat difficult in incipient cases. Aleucemic lymphadenitis, lymphosarcoma, bilateral dacryoadenitis, tuberculosis of the parotid glands, mucopurulent chronic parotitis, syphilis, etc., must be distinguished.

He cites two interesting cases, which he states differ from any yet published. The first case showed atrophy of the submaxillary, sublingual and lacrimal glands, with suppression of their secretion. In the second case the process had attacked the salivary and nasal glands with later involvement of the lacrimal. In conclusion, he states as his opinion, that the syndrome is a sclerosis of the glands with either hypertrophy or atrophy and either the deep or superficial glands may be involved. Because of the diversity of its manifestations and many differences from the syndrome originally described by Mikulicz, he prefers to call it by the title of this paper.

Samaja, distinguishes between pure forms, hypertrophy of the lacrimal and salivary glands, and forms associated with general lesions of the lymphatic system or with general infections; and further states, that the prognosis is in direct relation to the general disease, with which it is associated. He describes a patient in whom there was so great an amount of swelling of the pharyngeal glands in the right side that deafness ensued, due to occlusion of the Eustachian tube. Saliva was somewhat scanty. There were bilateral pterygia and papillary hypertrophy of the conjunctiva. Lacrimal ducts were pervious. The Wassermann was negative, the blood count showed the relation between the white and red cells to be 1 to 941. Lymphocytes 26.5%, large mononuclears 3.5%, polynuclears 66%, eosinophiles 1% Radiotherapy was followed by brilliant results. Six applications were made with a filter of 3 mm. spark equivalent 25, milliamperes ½, duration twenty minutes. Forty days after the last application, most of the enlarged glands had disappeared as had the deafness and tinnitus. The relation between the white and red cells was 1 to 604, and there was marked eosinophilia. **Askey** and **McKenzie** have also reported cases of this rare disease, and **Lindgren** described a case in which anemia set in and steadily increased, swelling of the spleen and liver appeared, and death followed after a course of seven weeks.

Marsh reports in detail a case in which the clinical picture was that of Mikulicz's syndrome associated with pulmonary and cutaneous lesions. Histologic examination revealed miliary tubercles in both the gland and the skin. Search of the literature reveals only three other cases of the kind beyond question tuberculous.

Detzel removed two lacrimal glands from a young man who presented a typical syndrome of Mikulicz's disease. They simulate very closely the lesions of tuberculosis, altho without caseation, bacilli or positive inoculation. He reviews 43 cases of this syndrome which have been published presenting the probabilities of tuberculosis and concludes; that the hypertrophy of the glands is due to a localized tuberculosis in certain glands. The infection is endogenous and is carried by the blood of the lymphatics. In a fifteen year old girl with Mikulicz's disease, a yellowish red granulation of the iris, which raised itself above the surface, was noticed by **Ohno.** Histologically, there were giant cells surrounded by young connective tissue and epithelioid cells, but without caseation. The parotids showed a similar formation. He states, that four cases of such involvement have been noted in the literature to date.

Schmidt takes for the subject of his inaugural dissertation Mikulicz's disease and **Stoppats** writes on the syndrome of Mikulicz, and **Schmalfuss** on the treatment of Mikulicz' disease.

Canaliculli. A number of papers have appeared during the past year suggesting various methods for restoring the canaliculi. They consist essentially in freshening the ends of the wound and carefully approximating the edges. **Stargardt** probes on the fourth day and introduces a thick catgut suture into the canaliculus, which he allows to remain for about three weeks, after which a probe will pass. **Dean** follows a similar method but packs the canaliculus after the operation. **Boyd** recommends the use of a canula in cases of closure of the canaliculus.

To repair laceration of the canaliculus **Reitsch** inserts a fine probe and unites the torn ends over it with fine catgut. The probe is allowed to remain in position three days. **Jeandelize** emphasizes the advantage of the retention catheter in the treatment of such injury.

CONCRETIONS OF THE LACRIMAL CANALICULI. **Shumway** presents two cases of concretions of the lacrimal canaliculi seen by him recently. He gives a brief historic sketch, in which he states that they were first described by Cesoni in 1670, and that the first clear description was that of Albrecht von Graefe, who proved that the concretions were of an organic nature. Seventy cases have been reported in all. The lower canaliculus is most frequently involved. There follows a general description of the condition. The bacteriologic examination of the first cases was quite carefully carried out and proved very interesting. Direct smears showed filamentous growths which were suspected of being fungoid in nature. Cultures showed three forms, a large bacillus with rounded ends, a short bearer which microscopically resembled the spore bearing members of the thread bacillus, and the thread bacillus itself. After careful watching, it was decided that all forms were different manifestations of the same organism, which was probably a streptothrix. **Ferdinand** has written an historical thesis upon the streptothricosis and has reported three such tumors of the lower canaliculus.

Villard has described a *prelacrimal furuncle,* developing in the region of the lacrimal sac, which might be mistaken for an acute dacryostitis. Altho he could find only two references to this condition in the literature, he has seen twenty cases in a total of 32,000. The disease is always unilateral, appears at any age, but preferably in the relatively young, is morbid equally for both sexes, and is usually a solitary condition. The onset is sudden, often with great pain; there is a red swelling with diffuse borders lying sometimes above and sometimes below the tendon of the orbicularis with perforation and evacuation of pus mixed with blood. The course is several days and there are no complications or sequels. The diagnosis from acute dacryocystitis is made by noting that pressure upon the sac is much less painful than in the latter, and there is nothing expressed thru the canaliculi. Syringing thru the lower canaliculus shows that there is free passage into the nose. If located above the tendon, it cannot be dacryocystitis. If it perforates, the opening is smaller, less ragged and there is much less pus in furunculosis. Treatment is by hot compresses in the early stages, or by incision or opening with a cautery if pus is present.

DACRYOCYSTITIS. Among the causes of lacrimal obstruction and inflammation of the sac may be peculiarities in the development of the tear passages such as those alluded to, p. 364. No anatomic studies were possible in his cases, but **Schnyder** reports the histories of two families in which the tendency to lacrimal disease was quite marked. In one family the mother, three of her children, and two of her grandchildren under 30 years of age were affected. In the other family among 7 siblings four were affected from infancy, and three others remained well up to adult life. **Cantonnet** has written on lacrimal ectropion.

The question of the course of infection between the lacrimal sac and the ethmoid sinuses, has been quite comprehensively studied by **de Peyrelongue** in a recent paper. He states, that it is very difficult if both are involved when seen for the first time to determine where the infection started. It is held to be generally true, that the infection begins in the sinus from whence arises the orbital involvement. But evidence that this is not always true is presented in the case which he gives in considerable detail. The paper will well repay careful perusal. In brief, there had been in the case described, a definite dacryocystitis for some time with no nasal involvement whatsoever. The ducts had been probed a number of times and there was no sign of ethmoidal disturbance, This continued after the removal of the latter, definitely proving an ethmoiditis. It is the author's opinion, that this was a secondary inflammation, resulting from a false passage made during the course of the probing. **Brunzlow** reviews the pathology and therapy in diseases of the tear passages in their relation to rhinology and **Monthus** on chronic disease of the lacrimal passages. **Cheinisse** reports the use of chromic acid in suppurating dacryocystisis.

Polypoid thickening of the lining membrane of the tear sac is reported by **Piesbergen**. The patient was a woman of 55 who had been treated for dacryocystitis, by probing and opening the sac. On extirpation the polypoid thickening of the membrane was demonstrated. **Guijarro y Carrasco** reports dacryocystitis after nasal injury.

TREATMENT OF OBSTRUCTION. General consideration of this subject has been very well given by **Ducatteau** in his Paris Thesis. He first discusses where probing is indicated and where cauterization or extirpation of the lacrimal sac is the operation of choice. In congenital cases massage is indicated, in 2 out of 3 patients it will disappear in six months after birth. It is rarely necessary to probe, which is particularly dangerous because of tenderness of the tissues. In simple adult cases, one should use, according to the author, a number three Bowman probe. He quotes Stilling as having found electrolysis, curettage, and dacryocystorhinostomy of value, especially in cases with abscess formation, but further quotes the same source as a warning that the results are inconstant. He reserves extirpation for those cases of mucocele or ectasia of the sac, which are not complicated by fistulas or adhesions to the skin. In tuberculosis, he removes the sac as completely as possible and then curettes the surrounding tissue, after which he thoroly cauterizes with the thermocautery, being especially careful of the region of the inferior opening.

Nagel discusses *congenital atresia* of the lacrimal duct, and states as his opinion, that it is much less rare than formerly believed. He advises the use of pressure and massage, and careful probing. The canal normally open at birth may be closed at the nasal end by a thin septum, a fetal residue, which usually atrophies and perforates as it stretches with the widening of the canal. Mayou states, that the lower concha partly closes it at birth. The canal is filled with detritus derived from the solid cord of proliferating epithelial cells, which formed the original anatomic substratum of the tear passages and by degeneration of the central cells of which canalization had taken place. This detritus is ordinarily removed by aspiration, but if this fails to occur, secondary infection may take place. Other contributing causes, are blocking of lumen by circular folds of mucosa, infraction of bones in forceps delivery, the curved course of the duct in infancy. The sac may distend considerably before noticed, as the fossa is somewhat larger than the sac. But, after expression, shrinkage rapidly takes place, due to the youth of the tissues.

Schousboe reports a case in which the congenital obstruction was osseus. **Barraquer** finds dacryocystitis commonly due to obstruction and preceded by a period of lacrimation. Displacement of the puncta may be the original cause. **Moon** finds epiphora the first symptom of dacryocystitis and urges that patients should be warned of the evil results of neglecting it. **Kraupa** has written on suppuration of the sac. Another interesting discussion of the general treatment of dacryocystitis, has appeared from the pen of **Wieden**, who has carefully described his methods of probing and general handling of these cases. A rather interesting paper by **Sauvineau** has appeared during the past year, that calls our attention to the fact that in many cases dacryocystitis follows excessive tearing, which in its turn is due to errors of refraction, such as astigmatism or hypermetropia, or to lack of the power of convergence. Then the resulting excess of tears overtax the passages which become blocked and later infected. The proper way to prevent these infections should, therefore, be to correct the underlying causative factor by proper refraction and attention to the muscle strain. **Fromaget** abstracting Sauvineau's article agrees with the views expressed. **Neunhoeffer** has written on disease of the tear passages.

TUBERCULOSIS. A case of tuberculosis of the lacrimal canal has been described by **Stenzler.** **Weber** has reported a case of lupus of the lacrimal sac.

LACRIMAL DUCT OPERATIONS. A method of cutting strictures of the duct when they lie at the juncture of the sac and duct, has been described by **Poulard,** closely resembling that described by Stilling and by Thomas. He introduces a number four probe thru the duct into the nose, after which deep anesthesia is produced by 4% cocain, used three times. Then a narrow knife with a rounded tip is introduced and the stricture incised. Following this, there is no difficulty in passing the largest probes. Healing takes place rapidly and without complications. At the most, probing with large probes five or six times at a few days interval, is all that is necessary. This operation is indicated in either chronic or acute cases, when the stricture lies as noted, which is by far the most frequent seat of the disturbance, as it is normally the narrowest part of the canal. **Green** has written further on his method of treating chronic dacryocystitis, by curettage and rapid dilatation. The details of this procedure were given in this section of the Y. B. for 1920 p. 244.

In cases of acute dacryocystitis, **Ball** under general anesthesia slits the canaliculus into the sac. A Weber dilator is then passed thru the strictured lacrimo-nasal duct. A number 9 Theobald probe is next passed thru the duct, and its presence verified by touching it with another probe passed intranasally. On the third and fifth days modified Bowman number 8 probes are passed. This plan has been followed by the writer for a number of years, with good results. **Killen** and **Killick** have presented case reports of treatment of chronic dacryocystitis and lacrimal obstruction.

DACRYOCYSTORHINOSTOMY. During the past year, as for several years preceding, a very voluminous literature, has appeared upon this subject. Most of these papers are comments and minor variations upon the original Toti operation. In general two different methods have been advocated, the open method, where the sac is incised thru the skin and an opening is made from it into the nose; and the closed method working thru the puncta into the sac and from thence into the nose, or in the contrary direction, from the nose into the sac.

The principal paper advocating the open method, was a beautifully illustrated and very complete article by **Dupuy Dutemps** and **Bourguet** wherein they described an operation in which an incision is made thru the skin over the lacrimal sac, which is exposed and pushed to the temporal side. A large oval opening is then made into the nose and the nasal mucous membrane is opened by an incision resembling a capital I. After this the sac is opened on its nasal aspect and the mucous membrane of the nose and sac are sutured together with catgut. The periosteum is included in the anterior sutures in closing, silk sutures are passed thru the skin. No deformity has remained after the operation. All cases healed by first intention, tho occasionally emphysema of the lids resulted for about two days. None of the cases had to go into the hospital. Thirty of the first forty one cases were observed two months after operation and required no intervention. This time was sufficient for healing or closure to have taken place.

The author's point out that in case of closure the result is similar to a resection of the sac. Of twenty seven consecutive cases two were failures, two were partial successes, and twenty three were complete successes. This method is contraindicated in stenosis of the entire region, destruction of the canaliculi, fibrous retraction and effacement of the sac, friability of its walls, skeletal deformities, tuberculosis or tumor, nor should it be used in abscesses; and in acute inflammations it is difficult to produce complete anesthesia. They also found, that slitting of the lower canaliculus did not interfere with the proper drainage. In about one half the cases air may be forced backward from the nose thru the puncta, when the nose is blown very hard.

Rubbrecht describes the operation that he has done in 150 cases with slight modifications to its present form. He secures anesthesia by nerve block thru a solution of novocain with adrenalin injected near the infraorbital foramen, and near the pulley of the superior oblique, along the inner wall of the orbit, to the depth of 3cm. His incision follows the direction of the lacrimal crest closely resembling that of Greenwood. To penetrate the bone he uses the dental engine. The mucous membrane is preserved for suture to that of the nose. The opening is packed with iodoform gauze extending into the nose far enough for its subsequent withdrawal. The skin incision is closed by interrupted sutures, which are removed after six or seven days. **Mosher** again publishes a description of his operation. (See Y. B. V. 12 p. 273).

Starting out to make a special study of the West operation in the eye clinic of the Royal Victoria Hospital in Montreal, **Mac Millan** has devised an operation which is somewhat similar to that described by **Burch.** Its essential features are, the sac is freed by an open incision in its surrounding fascia and cut transversely as far down in the canal as possible. A long silk suture is passed thru the fascia near the lower end, leaving each end of the thread long and unknotted. Next the lacrimal bone is exposed and an opening made thru into the nose with a sharp probe and enlarged with a blunt one. A piece of gauze may be worked back and forth thru this opening making the margins smooth. The orifice thus made is beneath the middle turbinate on the nasal side and in front of the fundibulum. Both ends of the suture are then caught by a forceps introduced thru the nose and nasal opening, and the sac is drawn down into the nose. The fascia is very strong and holds the suture well. The suture is then tied over a plug of gauze placed in the nostril for the purpose. The lacrimal canal is curetted as after excision of the sac and the skin is sutured. The plug is removed after the second day and the suture on the fifth day. The author reports very good results. In all the early cases general anethesia was used but immediately before publication a case was done under local nerve blocking. Following the operation a number 4 Bowman probe is introduced thru the punctum into the nose every third day or more often if necessary, depending on the tendency of the opening to close. Granulations are kept down by applications of 40% silver nitrat to the wound until entirely healed.

The closed method seems to have more champions. In order to avoid the mistake of incorrectly locating the region of the lacrimal sac from the nasal aspect, **Wiener** and **Sauer** have advised a very clever method of fixing its position accurately. A Ziegler probe is introduced thru the inferior canaliculus into the lacrimal sac. The probe is then directed downward until it reaches the bottom of the sac when it is turned inward at an angle of 45° and is then forced thru the external nasal wall into the nasal cavity. The probe will enter the latter just in front of the anterior end of the middle turbinate. The opening so made is then enlarged and a portion of the sac is pushed thru this opening by a probe. The sac is then grasped by a forceps which bite off this portion.

The nasal route seems to be the most popular method of operation and many modifications of it have appeared. **Walker** believes that an operation without external wound will be the ultimate solution because of the desire of the patient to avoid any deforming procedure. But if a dacryocystitis is present, requiring opening of the sac, he prefers to dissect it away from the nasal wall and chisel thru into the nose from the outside, later opening the sac into the nose. He points out, that when the wound is made from the nasal side it is liable to be narrow in its anteroposterior diameter because of the anatomic difficulties in reaching it. To avoid this tendency, he recommends the use of a burr, 7mm. in diameter and of spherical shape, to be used with dental engine. In cases where such is not to be had, he recommends the use of a specially devised chisel with the handle arranged in such a way that the hand of the operator can hold it in proper position while resting against the patient's cheek. He has also a specially designed Hartman forceps which has been grooved in such a way that when it grasps the lacrimal sac pushed into the nose by a probe, it will not retain the probe.

Blumenthal removes the mucous membrane from an area between the anterior attachments of the middle and inferior turbinates, somewhat in front of and somewhat behind a line joining them corresponding to the upper half of the crista lacrimomaxillaris. If the latter is absent, the border between the frontal process and the lacrimal bone must be outlined. He prefers not to preserve the flap. A hole is then chiseled from the crista in the upper part of the frontal process. This opening is enlarged until the finger within the infraorbital margin can press the region of the sac into it. The latter is then opened and its medial wall is resected. A probe passed thru the lower canaliculus locates the sac more definitely. The operative field is then tamponed with iodoform gauze and cold compresses are applied externally. The tampon is shortened each day and entirely removed after three days. The discharge of pus suddenly stops and if the operation has been correctly performed, no return need be feared.

Gummich, after a review of the different methods comes to the conclusion that the West-Polyak method is preferable. Thurman believes, that in phlegmon of the sac, the West operation is indicated. After careful review of his past experience with the various nasal operations, Müller asks, that the beginner be not discouraged but give them a trial. He recalls some of his early experiences and rejoices that his first three operations of this nature were successful, or he fears that he would have become discouraged, as some of his latter ones were most trying. He feels, that the West method is that of choice. He cites one case of corneal ulcer that healed rapidly after a successful operation of this nature.

Falgar gives a general review of the anatomy of the parts and expresses his preference for the intranasal operation as developed by West. **Veis** has described a new operation on the tear sacs.

Hirsch reports a case where bilateral dacryocystitis had existed for a number of years. On one side the sac had been extirpated while upon the other side, he performed a West-Polyak operation. There was tearing from the former side whereas the latter was normal. Hirsch advises to use an anesthetic in the nose and also to infiltrate the region about the lacrimal sac with Schleich's solution, for in excision of the medial wall of the lacrimal sac extreme pain is often suffered. **Whale** prefers the nasal route according to West. **Mc Cready** has reviewed the entire question and described the usual operation with no particularly new points. **Halle** and also **Heermann** have also written on the intranasal operation and its effects. **Bookwalter** has given a very careful description of the usual intranasal dacryocystostomy. He deplores slitting or in any way disturbing the puncta. The after treatment consisted in probing with Bowman number 1 for about eight weeks every fourth day. In fifty five cases observed for one year the results were good. 84 cases of dacryocystorhinostomy operated on in Elschnig's clinic were reported by **Bohm**, who describes the method in detail. The permanent result was, that 57 cases had entirely normal drainage of tears, 10.5% a partial communication. He concludes, that Totis' operation cures in about all cases the lacrimal suppuration, and renders the conjunctival sac germ free without special methods of disinfection. The most important points in favor of this operation are, the easy survey of the fields during operation and subsequent technic, and that it can be performed in considerable obstruction of the nose. **Hinojar** has special instruments to simplify the technic of dacryocystorhinostomy, and **Soria**, and **Blegvad** writes on dacryocystorhinostomy.

Extirpation of the Lacrimal Sac. **Greenwood** has given an exceedingly interesting and concise description of the proper method for extirpation of the lacrimal sac as follows; The patient is prepared as usual for such an operation and general or local anesthesia brought about. Local anesthesia is becoming more and more the custom, however. Prior to making the incision it is well to place a strip of adhesive plaster across the closed lids over the eye on the side to be operated on. It is then the author's custom to outline on the skin with the finger nail the exact position of the lacrimal crest.

A small scalpel should be used and incision started 1 or 1½ mm. above the triangular ligament and the cut made directly down to the bone and following along the crest, as close to the lip as possible, downward and outward, nearly 20 mm. in length. On separating this wound with one of the special retractors, like Mueller's, or by the use of heavy silk sutures passed thru the skin, it will be found, if the incision has been made properly, that the bone is exposed all along the lacrimal crest. The next step is to have the assistant hold up the upper angle of the wound with a large strabismus hook, similar to the Smith cataract hook. This helps to control hemorrhage and enlarges the field of operation. With a knife an incision should now be made thru the periosteum from above downward, if the first incision did not cut clean to the bone.

This periosteum incision follows as close to the edge of the crest as possible. Usually about ½ mm. is enough to prevent endangering a slipping over into the sac. On separating this periosteum to the crest it will be found difficult to go farther as here it is firmly attached to the bone and to the deep fascia and periosteum which are intimately interwoven at this point. It being impossible to separate the periosteum any farther a knife point can be used to cut thru close to the bone and at once the sac comes into view. The nick thus made should be enlarged upward and downward until the sac is thoroly exposed. The above method of finding the sac, which only takes a minute or two, has never failed in the hands of the author; and the postgraduate students, after they have once had this operation properly demonstrated to them, seldom fail to find the sac easily and quickly.

Following the exposure of the sac a periosteum elevator may be used to pry the sac from the anterior portion of the lacrimal fossa, this being part of the lacrimal crest of the maxilla and made up of heavy bone. Posterior to this, however, lies the portion of the lacrimal fossa which is made up from the nasal bone and here great care must be exercised not to perforate or enlarge the perforations which may already exist in this structure. At this stage the author prefers to use a strabismus hook, gently separating the sac from its posterior bed. Two hooks are very useful for this procedure and after they have been passed behind the sac they can be moved up and down until the sac is well freed except at the dome and at the entrance to the canal.

The above part of the operation can be done quickly, easily, and with no hesitation. The next step is a little more difficult, but is simplified by taking a broad hold on the temporal cut edge of the periosteum and fascia with a pair of fixation forceps. The deep fascia and periosteum are very much more prominent at the upper part where they are incorporated with the triangular ligament. Then the sac can be dissected from the deep fascia until it is possible to pass the strabismus hook completely around it. The hook can then be slid downward until it comes up against the bony ridge of the lacrimal canal. The sac is then grasped with mosquito forceps as low down as possible and cut off deep in the lower part of the fossa. The sac is now lifted out of its bed, the canaliculi cut and the dome of the sac separated from the upper part of the fossa. This is another point where a good deal of care is necessary because the sac at this point is very firmly adherent and usually has to be snipped away with the points of a pair of curved scissors. He also advises suturing the upper and lower puncta for 2 to 3 days.

West reports total extirpation of the lacrimal sac from the nose with restoration of the normal outflow in dacryocystitis. The bones from the lacrimal fossa are exposed from the nose, leaving the turbinates intact (sometimes the anterior end of the middle turbinate must be removed), and opened with the chisel whereby the tear sac at the lateral wall of the nose is laid free. The sac is removed with forceps. In this way a new direct communication between conjunctival sac and nose thru the canaliculus above the intact lower turbinate is established. The lacrimal duct has not been touched. West has, within the last 2½ years, performed the total extirpation of the tear sac in about 100 cases in which the severed canaliculus showed no tendency to obstruction. Its opening remains clear because the epithelium grows into the nose, around the corner, so to speak, and covers the region of the orifice.

Villard has outlined the four essentials of a successful extirpation of the lacrimal sac. They are (1) A dry field. (2) Do not incise the entire surface of the sac. (3) Do not commence the dissection of the sac until it is actually visible. (4) Always have the operative field in plain view.

1. Avoid cutting the vessels by making the incision as close as possible to the internal commissure about 2 mm. from it and not more than one or two millimeters above the direct tendon of the orbicularis. This with the use of adrenalin will give a practically bloodless field.

2. The success of the operation depends largely on this. The use of a groove director permits the tissues above the sac to be easily opened and protects the anterior surface of the sac. Also, if an acute dacryocystitis with perforation has been present.

3. A membrane is sometimes mistaken for the sac, and if removal of the sac is attempted too early in the operation, that is before the sac is actually in view, it is possible to penetrate into the orbit.

4. Altho the operative wound is very small, it is very important that each step be plainly visible. The straight scissors should be avoided as its point cannot be guided properly.

Rollet has described his technic for total extirpation of the lacrimal sac and of the membranous nasal canal. He makes a skin incision about 12 mm. long, the upper part vertical, the lower curved along the lacrimal crest, with a small bistoury. The lips of the incision are retracted with forceps and division of the tendon reveals the gray sac. The mucous membrane of the sac is destroyed with a rasp and that of the canal with a little gouge, 2 mm. wide.

Mendoza cuts down upon the sac with a semicircular incision and reflects back the flap thus formed. Then he works down to the periosteum and separates the sac from its bed, securing a good view of the parts dealt with. **Gil** has written on anesthesia for extirpation of the sac.

In cases of dacryocystitis, where the anterior wall of the sac is intact, to avoid as far as possible the making of a visible cicatrix and subsequent lacrimation **Jocqs** employs a method by which all the mucous membrane, except at the bottom of the sac, is destroyed with chlorid of zinc, 50 per cent. He describes his operation in detail. The method occupies 15 days altogether.

Wheeler is very enthusiastic about the removal of the lacrimal sac and warns of the danger of attempting plastic work in this region without first removing an involved sac. He cites four interesting cases. **Reeder** has described the West operation carefully but has added nothing new. **Ben Aouda** writes of the danger of infection following cataract operations etc. in the presence of an infected sac. He recommends probing and lavage of the sac before operation and in case of infection that it be removed at least six days before operation, the invariable procedure of Rollet. **Garcia del Mazo** mentions the results obtained in 256 extirpations of the lacrimal sac in different forms of infections. He believes it to be the safest procedure in the sac suppurations, and recommends that it be done as a routine in working men that are liable to industrial accidents.

Diseases of the Lids

FLORENCE MAYO SCHNEIDEMAN, M.D.

PHILADELPHIA, PA.

This section carries the literature from July, 1920, to August, 1921. For previous references see O. L., v. 16, 1920, p. 246.

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DIGEST OF THE LITERATURE.

PHYSIOLOGY OF LID MOVEMENTS. **Haahti** and **Vuorinen** have studied the frequency of the act of winking under different conditions. The experiments were so made that the examiner registered the lid movements of the person under examination by means of an electrical signal, without informing the individual of the purport of the tests. The results were as follows: 1st, the number of lid movements is extremely variable; a healthy person may wink 5 to 40 times per minute, which variability can not be ascribed to any definite influences. 2nd, In the case of the same person, the frequency of lid movements varies markedly under normal conditions, altho, in general, within narrower limits than among different individuals. 3rd. The frequency of the lid movements is dependent upon a number of determinate influences: (a) Physico physiologic: this class occasions reflex movements of the lid, especially thru the optic nerve and the sensory nerves of the surface of the cornea and conjunctiva; their tendency is to increase in frequency under the stimulation but to tend to diminish with increased moisture of the parts. The most important of these influences are; air currents, moisture and heat and cold: light and the position of the eyes are of next importance. (b) Psychophysical influences: these are probably manifold and may increase or diminish the frequency of the movements; they also exert a disturbing influence upon their rhythm. Among the physical influences more carefully examined, the first place is ascribed to the individual's attention; as this increases the frequency of the lid movements constantly diminishes.

Salisbury-Sharpe contends that the closing of the eyes during sleep is not due wholly to inhibition of the action of the muscles which raise the lids, but is completed by contraction of the orbicularis. In a condition of complete inhibition of all palpebral muscles the lid droops, but the eye is by no means closed. It is known that the eyes do not actually close in death, and in complete facial paralysis and advanced stages of exhaustion by illness closure is also incomplete.

Kisch had previously referred to a palpebral reflex which he was able to elicit by irritation of the external auditory meatus, and especially of the drum. He considered the path to be *via* the V and VII nerves. This is a different reflex from that of Bechterew, which arises from the VIII nerve *via* the nucleus of the VII. The reflex of Bechterew is useful in the diagnosis of organic deafness, while that of Kisch is only for the testing of the trifacial. **Cemach** and **Gallant** write on the aural lid reflex, and **Rendu** reports associated movements of ear and lids following facial paralysis.

ANOMALIES. **Poyales'** case, a male infant, 12 days old, had a coloboma of the right lower lid which was continued over the face parallel to the nose, and terminated in a lateral hare-lip. There was also an amniotic strand which extended from the angle of the coloboma to the center of the cornea. The lower lid of the other eye showed a very incomplete coloboma, likewise accompanied by a cicatrix parallel to the nose. There was also a complete cleft of the palate. Poyales considers van Duyse's theory as the most satisfactory explanation of anomalies of development like the above.

According to this theory coloboma is determined by developmental modifications of the amnion: amniotic strands may become fixed to the eye and so offer a hindrance to the development of the lid. The above case quite confirms this hypothesis. The vesiculae ophthalmicae are the most projecting parts of the cephalic extremity and therefore come most readily in contact with the amnion; there can be no doubt but that amniotic strands are the cause of such malformations. The right eye is microphthalmic, which developmental fault is explained by the circumstance that the amniotic strand which is attached to the cornea, caused a keratitis during the period of development, the repercussion of which irritation upon the ciliary body gave rise to a chronic cyclitis: the latter is directly responsible for the defect of development, i. e. atrophy of the eyeball.

Thylmann analyzes 119 cases of coloboma of the lid with the description of a personal case. The latter, a girl of 13, otherwise healthy, presented a trapezium shaped coloboma of the left upper lid, 12 x 5 x 4 mm. in dimensions, involving the entire structure of the lid. The margin is studded with lanugo hairs. Lacrimal apparatus and internal structures normal, but vision only .5 in both eyes; Symblepharon like adhesions in the nose preventing proper movements and calling forth a desire for relief. Bridge of the nose somewhat widened. Skin above the defects and to the orbital margin somewhat poor in pigment but not scarred. Skin and hairs otherwise normal. No clefts, no anomalies in the family.

Analysis from the literature, referred to, described the situation and shape of the coloboma noted and reports upon remaining ocular structures and organs. Van Duyse's theory best explains the anomaly. In 11.6% remains of amniotic structure are clearly shown to be present; the amniogenic origin of malformation complicating lid colobomata, such as dermoids of the corneoconjunctival margin, pterygium like formations, conjunctival folds, tumors of the lids, auricular outgrowths, deformations of the nose, displacement of the limits of the hairy scalp, developmental defects of the extremities, etc., have been practically proven.

Keutgen reports 2 cases of epitarsus, affecting the four lids. Three mm. behind the lid border, a peculiar discoloration of the conjunctiva commenced, extending over the retrotarsal fold to the ocular conjunctiva, reminding one of the greyish white aspect of the conjunctiva in vernal catarrh. Keutgen adopts the explanation of Oeller, who attributes this rare affection to a supernumerary third lid in the embryo.

Kirsch reported an interesting case of so called epitarsus. It was seen on a grayish pink fold over the upper fourth of the tarsal portion of the conjunctiva of the upper lid. The fold was between 2 and 3 mm. across and 12 mm. broad. When cocainized a small probe could be passed completely under the fold. The author reviews the literature on the subject and illustrates the condition with an excellent colored plate. **McMullen** observed a congenital malformation of the outer canthus. The extremities of the left lids were separated by a low pad or cushion of tissue covered with skin. The suggestion of an amniotic band and adhesions, before the displacement, seemed to him a plausible one. **Kraupa** reports observing occasionally in the shape of a triangle a prominent vein in the subconjunctival tissue emerging from the temporo-palpebral ligament and again submerging in it. The vein was three times wider than the other episcleral vessels; its shape was approximately the same in all cases, but its course toward the limbus varied. The eyes were otherwise perfectly normal, so that the venous loop must be regarded as a congenital anomaly and should not be confused with dilated episcleral veins encountered in pathologic conditions.

Ptosis. **Popper** reports the case of a woman, aged 38, who had been affected with multiple sclerosis from her 16th year. There was slight ptosis of the right upper lid. Upon looking to the right, with the exception of an occasional jerk, but no typical nystagmus of the ball, spasmodic jerkings of the right upper lid generally occurred; upon glancing to the left, there was nystagmus of the eyeball, which latter, at a certain definite near approach of fixation, was associated with nystagmus of the upper lids, particularly of the right. A striking circumstance appears in that the lid nystagmus was most marked in the lid affected with ptosis, and occurred alone even when nystagmus of the bulb was absent. Upon looking to the left, that is in the direction of the stronger bulbar nystagmus, the lid nystagmus of the right upper lid is much more marked than when looking toward the right. The reporter is of the opinion that this is not so much an instance of pure concomitant movement, but rather an overflow of stimulus from bulbar nystagmus to the levator nuclei (diffusion of stimulus). This diffusion finds the right partially damaged levator nucleus a sort of *locus minoris resistentiae* and thus leads to lid nystagmus, even when bulbar nystagmus does not occur by reason of a too weak stimulus. **Liebault's** three cases of frontal sinuitis followed influenza; they were accompanied by ptosis on the affected side, but lumbar puncture showed merely slight increase of tension. Under medical treatment of the nose to disinfect and reduce congestion, the acute condition soon healed in one case, and returned to the previous chronic stage in others. Surgical intervention during the acute stage would probably have aggravated the condition and invited sepsis.

Rowland reports monolateral ptosis consequent to intracranial tumor. **Poulard's** operation for ptosis consists in utilizing two flaps of skin from the lid for attaching the falling margin of the lid to the occipitofrontalis. These cellulocutaneous flaps, veritable living cords, pass under the integument of the skin, from the brow to the forehead, in a subcutaneous tunnel, the upper opening of which is formed by frontalis incision, and the lower opening by the loss of substance at the point where the small flaps were taken. The upper and lower extremities of these flaps are attached to the frontalis and tarsus respectively by sutures.

In the discussion Terrien inquired whether these two external flaps would not become relaxed in time.

Terson observed that those operations for ptosis which make use of tongues of skin (Panas, etc.) without resection rapidly lose their effect from relaxation of the cutaneous bridge. Better and more durable results are obtained by cutaneous resection of appropriate shape and dimension, combined with union of the suspensory ligament with the brow and frontalis muscle by sutures. Dupuy-Dutemps remarked that to raise a lid is very simple, but keeping it in this position is another matter. The Motais-Parinaud procedure with resection of the upper lid, gives the best results. In **Ellett's** Motais operation for ptosis, performed 4 years ago, the result was very good, altho not equally so in the two eyes; a greater result was obtained in the right eye and the child tends to sleep with the eye open and there is occasional corneal irritation.

Delorme believes that of all surgical interventions for ptosis, Motais' operation is one of the most elegant and suitable when the superior rectus is normal and that if a satisfactory result is not uniformly obtained, such partial failure is due to the technic which does not permit of securely fixing at the point it should occupy, the strip of the tendon of the superior rectus. There are two essential points: To spread out the tendinous strip between the skin and the tarsal cartilage, with both of which tissues it should form intimate union; to favor adhesion between the palpebral and bulbar conjunctiva, to form a symblepharon in which the tendon shall pass. In the procedure, as formulated by Motais, a small tunnel is hollowed out with scissors between the tarsus and the skin of the upper lid; the tendon is made to pass thru this tunnel, but it is impossible to be certain whether it has penetrated to the bottom or been arrested in the wall near the entrance: if this should happen, the operation may fail or at least fall short of a perfect result. On the other hand, sufficient care is not taken to bring the palpebral and bulbar conjunctiva into perfect coaptation: it is the tendon alone which establishes between these two structures an extremely fragile bridge which is subsequently covered with mucous membrane. To remedy these two inconveniences, Delorme proposes the following modifications. As the first step, after the metallic protector has been inserted, he incises the skin and muscle parallel to the palpebral margin almost on a level with the upper border of the tarsus, about

2 mm. in length. The inferior lip of the wound is dissected off so as entirely to denude the tarsal cartilage to near the ciliary border. The upper lip is drawn upwards and the eyeball downward for the section of the tendinous slip, to be made in the superior rectus, exactly as advised by Motais. Delorme, however, does not believe in making a T shaped incision in the conjunctiva; this membrane is sufficiently supple and mobile to permit of exposing the tendon by a curvilinear incision 1 cm. from the limbus, or more exactly, on a level with the upper margin of the tarsus. Two threads are then passed to bring into apposition the two lips of the conjunctival wound to the corresponding edges of the palpebral button hole; the sutures are 4 or 5 mm. apart so as to leave between them a space sufficient for the passage of the tendon. The tendinous slip with suture is then inserted into the palpebral buttonhole. The lid is replaced in front of the globe, the two sutures are drawn tight, taking care to bring the palpebral and bulbar conjunctiva into perfect apposition. The tendinous slip comes thus to lie in a sheath of conjunctiva in its passage from the eye ball to the lid, being spread upon the tarsal cartilage and sutured to the skin as in Motais's procedure; two sutures of the palpebral wound complete the operation. The sutures may be left in place as they are perfectly tolerated, or they can be removed, if desired, having been made to pierce the skin, and tied when the tendon has been fixed in the desired position; they may be removed after 10 days at the same time as the suture of the tendinous slip.

The principal merit of this procedure is that while it changes nothing in the principles of Motais's operation, it permits of greater exactness in the execution. The junction of the tendon to the upper lid becomes perfect and the two threads suturing the conjunctiva protect the tendon and make between the eye ball and the lid a solid symblepharon; the palpebral cicatrix is insignificant. Several diagrams illustrate the operation. In **Zentmayer's** case of congenital ptosis, the drooping was very slight in the right eye, but in the left eye, even with the aid of the frontalis, the upper half of the cornea was covered. The greater deformity was the hemifacial furrowing of the forehead by the contracture of the frontalis. The result of the operating performed upon the left eye only was very good, the fold produced by the operation and the elevation of the lid was exactly symmetric with the natural fold and position of the lid of the other side. The lid could be well closed, the folds in the forehead had disappeared. **Aubineau** subjects the various operations for congenital ptosis to a critical analysis. They may be divided into two groups: the first, substitute the superior rectus for the elevator of the upper lid; the second includes those which leave untouched the eye ball itself, but seek to utilize either the frontalis or the levator itself (advancement). It was Motais (1897) who suggested the idea of using the superior rectus in the operation of ptosis. He based his plan upon the anatomic connections (identical innervation and course) of the two levators and upon their physiologic connections (simultaneous contraction of the two muscles when looking upwards). Motais's idea was resumed by Parinaud some months later with a different and simpler technic. Motais's plan achieved great notoriety; in fact, all who employed it remarked upon the decided result obtained when the glance was directed upwards. But fundamental objections arose against the principle of the operation. Morax (1901) drew attention to the unfortunate results of the anastomosis of the two elevators in the movement of palpebral occlusion. Sourdille (1903) justly insisted upon the dissociation and antagonism of the movements of the lids and eyeball during two important physiologic acts; winking, and palpebral occlusion during sleep. The idea of employing the occipitofrontalis to supplement deficient action of the elevator, commonly attributed to Hunt of Manchester (1830), is in reality very old. The writer refers to several procedures and describes in detail the operation of Hess (1893) as the simplest operation in technic and most satisfactory in results. This method of palpebrofrontal anastomosis has amply established its value in practice; it is based upon secure anatomic and physiologic data, based as it is upon normal vicarious action of the frontalis in congenital ptosis. Aubineau admits that in the act of looking upwards, Motais's operation is incomparable. But the operations addressed to the frontalis, while respecting the independence of the eyeball do not interfere in any way with the physiologic movements (occlusion) for which such independence is a necessity; all complications are easily avoided and the technic is very simple.

Blatt describes his operation for ptosis.

BLEPHAROSPASM. **Pimenta Bueno** states that in blepharospasm or blepharorrhaphy, or where there is hypertonus or hypercontracture of the orbicularis on one side, the anterior pole of the cornea on the sound side will be higher. He calls this the contralateral eyelid-eyeball sign. **Williams** reports blepharospasm attributed to ocular irritation, but due to a psychic habit.

Martin reports a case of *spasmodic* tic relieved by operation. The nerve trunk was exposed and caught up with a strabismus hook and stretched until the index finger could be passed under it. Then stretched again until the point of breaking. The nerve was then allowed to drop back into the wound in a coil about 2 cm. in diameter. The immediate result was complete relief from spasm lasting 8 months. The nerve was then cut giving relief altho facial paralysis persists.

PARALYSIS. A case of paralysis of the lids following diphtheria is reported by **Lichtenstein.** Paralysis of the lower lids is the title of a paper by **Sardou.**

MONILITHRIX OF EYEBROWS AND LASHES. **Soby** and **Kattan** report the case of a boy, aged ten years, weak and anemic, with the hair of his eyebrows very scanty and cut off short, so much that at a distance one might judge that they were totally absent. The margins of the eyelashes are inflamed as in an ordinary case of ciliary squamous blepharitis. The eyelashes are not scanty, but they are cut off short, dry and not glossy. It was gathered from the statement made by his father that the case was congenital, as the hair fell off on the third or fourth day after the child's birth on removing a cap from its head. The scalp does not present either bald area or broken or split hairs. In fact the hair of this part is quite smooth and glossy. On examining the eyebrows closely the skin is found to be not in the least inflamed, nor does it present any difference in hue from the neighboring skin. It is somewhat thickened but uniformly so, and gradually merges into sound skin exhibiting no patch or plaque. It is neither rough nor scaly. Hairs are scanty here and there, some are perfectly normal tho few in number; others are dry and cut off short. An interesting feature is the presence of small dark spots, which on close examination with a lens reveal themselves as tiny hair roots shut up in their follicles by a transparent mass of cory substance. In this case a striking feature is the presence of characteristic nodose hair in which there are along the shaft alternate swellings and contractions, the hair presenting a bead appearance and breaking easily at the constricted portion. In explanation it is stated that the apparently expanded portions represent the normal hair, while the constricted atrophic portions are the result, of development during a periodic increase of the cells of the rete mucosum of the hair follicles naturally, together with hyperkeratosis of the hair follicles. It is well worth mentioning that this disease affects more than one member of the family; whereas in this case this boy is the only one in the family, and this boy shows no signs of rickets.

The clinical features common to the classical case are:

1. The disease affects the hair growing after the fall of the fetal or infantile hair. 2. The keratosis of the

follicles, especially at the back of the neck.

When the case was first seen, it was taken to be one of ordinary blepharitis. There is another disease of the hair called "trichorrhexis," similar to monilithrix in that the shaft of the hair is nodose. In this disease, however, the swollen part of the shaft of the hair is the diseased part and looks grey; moreover there is no keratosis. The reverse is the case with monilithrix, in which the swollen part is the healthy portion and looks grey. The condition of this boy has continued the same over two years.

MULTIPLE ULCERS OF LID MARGINS. **Crisp** reported a case of multiple ulcers of the margins of the eyelids in a man of 43 years. The ulcers, three on the upper and two on the lower lid margin, varied in length from about two to four mm.; they were shallow, with slightly raised red edges. The patient had also four putrescent tooth stumps. In spite of treatment, no tendency to healing was definitely shown until after removal of the teeth, when fairly rapid improvement of the local condition set in with decided amelioration of the general health.

MOLLUSCUM CONTAGIOSUM. **Kingery** found that the cause of the disease was a filterable virus, which did not grow on the usual culture media. Upon intracutaneous injection in man, the typical lesion was produced in about 8 weeks. The various stages in the growth of the moluscum could be examined histologically, and are described. The lesion affects especially the glands of the roots of the hairs, but can develop independently of this, as is shown by analogous lesions in the chick and dove. That these are identical, however, can be proved only after appropriate experiments.

ABSCESS. **Hafner** treated successfully with barm, cases of lid abscess, blepharitis marginalis, conjunctivitis eczematosa, phlyctenular keratitis, catarrhal ulcer, dacryocystitis. It was given internally in the form of tablets or powder, 2 or 3 spoonsful in coffee, soup or milk before meals. Locally it was used in the form of powder or paste. **Longe** writes on the treatment of cancroid of the lids. **Simon de Guilleuma** has obtained rapid cure of lid abscess and other localized palpebral infections by ion therapy with *ion zinc*. The electrolyte is a 1% solution of very pure zinc sulphat. After washing the skin with alcohol, a piece of cotton with the warm solution is applied over the diseased region. On top is placed the prepared electrode, covered with cotton and a bandage over all. The electrode is then connected with the positive pole, while the negative pole is held in the patient's hand; the current is increased up to 2 or 3 m. a. for one half to one hour; and then the rheostat gradually withdrawn; only a few sessions are required.

GANGRENE. In **Satanowsky's** case as also in those of Schillinger and Steffens, a new born infant developed partial gangrene of the lids of both eyes; diphtheria bacilli were present. A few other cases of diphtheritic gangrene of the eyelids in infants have been reported, but in these the affection of the lids was secondary. **Garcia Mansilla** also writes on gangrene of the lids.

VACCINATION OF LID. **Espino** observed a typical vaccination of the eyelid, produced by the patient himself by transference from the primitive vaccine to the lid. There was fever with congestion of the eyeball.

MALIGNANT HORN. In **Hine's** case, patient presented a malignant sebaceous horn of upper eyelid with large recurrence; great benefit had so far accrued from a single (8 hour) exposure to radium.

EDEMA OF THE LIDS. **Wirths** reports a case of bilateral swelling of the upper lids, with swelling of the upper lip; the swelling of the lids was symmetrically located on both sides in the temporal portion. Histologically these growths were found to be lipomas or angiolipomas, with large formation of gland tissue upon the right side; Wirths regards this tissue as a portion of the lacrimal glands, which had been accidentally excised. The tumor of the lid consisted principally of mucous glands and was considered by the reporter as an hypertrophy of those structures. A case similar, from the clinical and histologic point of view has been described by **Ascher.** **Olano, Lobo, Martin** and **Gonzalez** report acute edema of the lid cured by intravenous injections of neosalvarsan; and **Fox** reports chronic edema of the lids.

XERODERMA PIGMENTOSUM WITH DISEASE OF EYEBALL. **Chevallereau** and **Offret** report a case of xeroderma pigmentosum in a boy of 13 with good family history. The affection began two years before the report with a small papule at the canthus of the left eye; at the same time several other small papules appeared upon the face. As regards the disease of the left eye, the physician who first saw the lad reports a tumor of the limbus involving the cornea and conjunctiva, strongly adherent, rose colored, readily bleeding and the size of a small hazel nut; the tumor was removed but recurred at once and increased enormously. Microscopic examination showed it to be an epithelioma of extreme gravity. The eye was enucleated by extensive incision of conjunctiva and healthy tissue; healing normal. The following lesions are now present; face, classic manifestations of xeroderma pigmentosum; here and there small telangiectasies and atrophic white spots. The dominating lesions are yellow pigmented spots, some slightly raised, forming small tumors particularly upon the lower lids. Near the commissures of the lips and upon the alae of the nose are small dry warty horns, some ulcerated and infected; lymphatics not enlarged. The hollow of the right ear is filled with a tumor springing from the border of the antitragus; this tumor is mamelonated, sanious and covered in large part by a brownish membrane. The right eye presents a tumor upon the inner part of the sclerocorneal limbus, slightly involving the cornea—a papillary epithelioma. This growth, as well as those of the face and ear, were removed; they were all found to consist of malpighian pavement epithelium in various stages of malignancy from the precancerous of the eye to evident malignancy of those of the skin and especially the ear. All the sections showed inflammatory lesions intimately connected with neoplastic formations; numerous cocci, for the most part of the diplo variety, were noted. As regards therapeutics, the history of xeroderma pigmentosum teaches that this disease requires an extremely somber prognosis. DuCastle writes that it is exceptional for the patient to live long beyond adolescence. In this case the X-rays were energetically applied with manifest amelioration; altho in Darier's opinion radiotherapy should not be employed in malpighian epitheliomas.

Bross reports general xanthomatosis affecting lids.

PLASMOMA. In **Schwarkopf's** case a boy, aged 14, exhibited under the convex margin of the tarsus of all lids, thick infiltrations, as hard as cartilage, increasing in size toward the retrotarsal fold and bulging like rollers; the conjunctiva over them was movable. The tumors were extirpated with good result, showing their benign character; they consisted of plasma cells, as originally described by Unna. There were no changes of the blood, bone marrow or internal organs. Clinically they may be confused with amyloids.

SYPHILIS OF LIDS. **Langrock** finds that the initial lesion involves the eye in the proportion of 3 to 4.5% of facial chancres; the brow is but rarely the seat (one case in 11 in German literature). The author adds a personal case; the differential diagnosis offers but little difficulty where the lesion is accompanied by marked induration with preauricular and submaxillary adenopathy and more or less analgesia. Chancre is to be differentiated from carcinoma, sarcoma, indurated acne, insect bites, etc.

Marin-Amat reports three cases, two of which presented the classic symptoms, while the third is remarkable for the extent of invasion of the entire surface of the upper lid, reaching a depth as far as the tarsus and suspensory ligament. The interest of these three cases resides particularly in their rapid response to treatment. In the first, 4 intravenous injections of neosalvarsan (15, 30, 45, and 60 c. g.) effected a cure; the ulcer had decreased one half 48 hours after the first injection. In the second case (phagodenic chancre) only a single injection of novarsenobenzol (Billon) was required (the medicament not being attainable at the time in Spain). Marked improvement was noted as early as the first day following the injection. Treatment was continued with intravenous injections of cyanid of mercury and then, because of intolerance, with gray oil. In the third case (chancre of the conjunctiva and lower lid), cure was obtained at the expiration of 16 days, following three injections of novarsenobenzol Billon (30, 45, 60 c. g.)

The author recognizes the powerful effect of this treatment upon the primary and secondary manifestations of syphilis, but he does not believe in the *therapia sterilisans magna* proclaimed by Ehrlich. He advocates the association of mercury, which latter should be administered for a considerable time during the periods of latency. In this he is in accord with the majority of clinicians. **Maucione** reports three cases of ulcerative *gummatous lesions* of the tarsus. All occurred in young adults with acquired syphilis—two in tertiary lesions and one secondary. All three had received more or less thoro treatment with mercury previously; they were all cured of local symptoms in about two weeks by from two to three injections of neosalvarsan. The reporter considers that all three cases originated primarily in the deep tissues of the tarsus, effecting the conjunctiva and skin only secondarily. In diagnosis, the absence of swollen preauricular glands helps to distinguish the lesions from tuberculosis, and their rapid growth and occurrence in young adults distinguish them from malignancy. Eighteen previously reported cases, fifteen in acquired, and three in hereditary lues, are referred to; it appears that neosalvarsan offers a much more rapid and complete cure than the older methods.

BLEPHAROCHALASIS. In **Heckel's** case of blepharochalasis in a young woman, an upper lid began to swell at times with a slight droop with the development of the menses. The droop gradually increased so that it became complete, with proptosis of 3 mm. A crescent shaped piece of skin, with the subcutaneous tissue and some orbital fat, was excised and the wound sutured with interrupted sutures; the result was entirely satisfactory.

Microscopic examination showed thickening of the stratum corneum with flat epithelial cells in many layers. There was an absence of adipose tissue in the corium and general atrophy of the papillae. The stratum reticulatum was deficient in elastic fibers, showing a general atrophy. There was wide separation of the fibers in the subcutaneous cellular tissue, suggesting a preexisting edema.

Lemere reports a case of blepharochalasis in a man. **Ascher** describes a triad of symptoms consisting of blepharochalasis with struma and duplicature of the mucous membrane of the upper lip, which has not been observed heretofore. The swellings of the upper lid observed in Basedow's disease are not identical with blepharochalasis; relapsing edema, mentioned by Stefenson as forerunners of subsequent blepharochalasis, are more nearly related to it. The author does not consider the coincidence with struma and duplicature of the lip as simply accidental; it is probable but not yet proven that secretory disturbances of the thyroid play an etiologic role in the occurrence of the syndrome. He has observed a number of instances of this triad of symptoms.

FOLD FORMATION OF BULBAR CONJUNCTIVA. **Braunschweig** reports a case of this very rare disease of advanced life; he was unable in fact to find any reference to any similar condition in literature. The patient was an elderly man who complains of extremely annoying burning and pressure in both eyes, which were wont to occur intermittently and suddenly without recognizable external cause. The pain was so severe as to be entirely disabling. At first sight both palpebral and bulbar conjunctiva appeared healthy; a casual remark of the patient that sudden closure of the lids brought on lightning like pains led to careful observation during an attack which gave the clue to the phenomenon: upon sudden repeated closure of the lids, a narrow lip shaped fold of bulbar conjunctiva was frequently observed to be caught between the interpalpebral margins of the lids; the fold gradually smoothed out; when this was complete, pain vanished. The writer explains this occurrence as a loss of elastic fibers. A crescent 2 mm. long and 1 cm. wide, 5 mm. from the limbus and concentric with it, was excised with complete cure. Braunschweig had the same good results in two other cases and contemplates operating upon a fourth.

Schreiber reports two identical cases. One of the patients had also blepharochalasis, whereby the reporter considers the similarity of both conditions as proven. Schreiber is not convinced that Braunschweig's assumption, that atrophy of the elastic fibers as the cause of the conjunctival affection, is probable.

INFLAMMATION OF MEIBOMIAN GLANDS. In three individuals affected with ozena, **Pereyra** encountered a chronic inflammatory affection of the eyelids localized in the meibomian glands, characterized by plaques of dull yellow upon the tarsal conjunctiva and by a discharge from the excretory pores of those glands of a yellow viscous substance. The process was cystic degeneration with hyperkeratosis of the body and excretory duct of the gland due to an encapsulated bacillus, not taking Gram's stain and which by its cultural characters resembled the *bacillus mucosus ozenae.* The writer believes that the affection had a pathologic relation with the ozenous process of the nasal mucous membrane.

Libby and **Finnoff** noted a case of granuloma of the Meibomian glands which were cauterized with improvement. In the discussion following Crisp advised opening up such growths, while Walker preferred to remove them thru intermarginal incisions. Magruder urged the use of heat and massage.

Steindorff reviewed the various diseases of the lids which are encountered by the general practitioner, and enumerated the most effective methods of treating them.

CYSTS. **Cavara** divides acquired transparent cysts of the lids according to their seat into; 1. cysts of the skin of the lid, (2) of subcutaneous connective tissue, (3) of the meibomian glands, (4) of the glands of Krause; he observes that with the exception of the rare cases of cysts derived from the Meibomian glands, it must be concluded that true transparent cysts of the lids spring from the glandular elements of the skin. He recalls that Tortuferi was the first to demonstrate, from pathologic histology, and experimental pathology, that those cysts which are seated upon the ciliary margin are derived from the glands of Moll, and are transparent cysts in the true sense of the word; that it is necessary to differentiate other cysts which occur at a distance from the ciliary border in the skin of the lids which spring from the sudoriparous glands of that region and which have been designated by Tartuferi by the term sudoriparous cysts—a variety to which, with the exception of Zeller, almost no author has paid attention. Cavara reports a case of sudoriparous cyst with histologic examination, showing clearly that the cyst was formed at the apex of a sudoriparous gland and should be regarded as a sudoriparous cyst of the skin of the lid. As to the mechanism of formation of these cysts, the writer is of the opinion of Majocchi that the efficient cause is an obstruction in the excretory canal of the gland from sclerosis of the surrounding connective tissue, or rather to the occlusion of the opening from hyperkeratosis of the skin.

In **Duclos's** case, a man, 43 years old, a block tumor of the size of a pinhead appeared on the margin of the lower lid, and in six months developed to the size of a pea. It was excised, with skin and tarsus. A complete microscopic description with several illustrations is given. The tumor was developed probably from glandular cells arrested in their development, which subsequently started to grow in the form of a cyst.

In **Majewski's** case between a nearly intact cornea and lids adherent at the canthi was present a cyst filled with a transparent fluid; upon opening the cyst the latter emptied itself with a spurt; the fluid did not appear to be of inflammatory origin, but more probably of retained tears. A strongly positive Wassermann with a history of lues was suggestive of the etiology. A burn three months before the beginning of the affection is to be negatived as a cause. Operation consisted of separation of the adhesions between the lids. The other eye presented a symblepharon of the upper lid; transplantation of conjunctiva of rabbit gave an unsatisfactory result in this eye as regards motility.

TRICHIASIS. **Diaz** discusses the origin and treatment of trichiasis and entropion. He carries the incision thru skin and muscle to the tarsus, 3 or 4 mm. from the free margin; division of the latter to the roots of the lashes; the sutures are inserted into the upper surface of the tarsus, emerge in the upper lip of the wound and brought out behind the lashes. The result is only to be considered satisfactory when none of the lashes are lost.

Layson employs the following method for correcting trichiasis, especially where there is also considerable ptosis, as in those cases resulting from trachoma. The skin incision is made parallel to and about 2 or 3 mm. above the lid margin, along the entire length of the lid and down to the tarsus. The flap so formed is dissected free from the tarsus up its superior border. The lower skin flap is then dissected free from the tarsus down to the lower or free border of the tarsus, and the dissection continued around this lower border, detaching the palpebral conjunctiva upward for about 2 mm. on the under surface of the tarsus. This strip of tarsus, about 2 mm. in width, and tapering at each end, should be dissected free thruout the length of the tarsus; this portion of freed tarsus is then excised; care should be taken to avoid button-holing the flap when freeing the conjunctiva from the tarsus; any fibers of the orbicularis remaining on the lower flap should be excised, as should also be done in case of redundance of skin in the upper flap, before placing the sutures. Three or 4 silk sutures are passed with a curved needle from without inward thru the lower skin flap, then thru the tarsus alone at its upper border, then from within outwards thru the upper skin flap. When the sutures are tied, the cilia portion of the skin is placed up and away from the eye; and the newly made lower tarsal border is covered with conjunctiva. Besides correcting the trichiasis, the operation markedly obliterates ptosis. Two diagrams (A. J. O. 1920, p. 434.)

ENTROPION. **Kraupa** observed a case of congenital entropion of both lower lids in a seven months old infant. The skin next the lid margin was raised into a fold by the subjacent tissue, turning the lashes 90 degrees inwards against the ball. No epicanthus, no epiblepharon, no blepharospasm. Holtz's entropion operation relieved the condition in both eyes; marked hypertrophy of the orbicularis fibers adjacent to the margin of the lids was present; tarsus normal. This was evidently a prestage of the true entropion (c. f. Meller, Klin. M. f. A. Vol. 58, p. 395) and not true trichiasis. Such cases are extremely rare; tho more common among animals. The author reports a personal case in a young hound; in this case hypertrophy of the orbicularis was found to be present at operation. Haltenhof (Zeit. f. vgl. A. 1885 p. 65) has observed the same congenital anomaly in dogs.

Ellett operated upon an old case of trachoma with entropion of both upper lid, pannus and a small corneal ulcer of the left eye. Vision right 18/200 left 5/200. Beard's "Altogether Operation" was done; intermarginal incision, canthoplasty, Hotz operation and a mucous graft from the lip between the edges of the intermarginal incision. Neither graft took, but the result, nevertheless is very good. Vision in the left eye rose to 10/200. The same surgeon performed a Hotz operation for entropion upon a second case of chronic trachoma with a satisfactory result.

In correcting entropion, **Ruiz** removes an oval area from the lower lid parallel to its border. The structures down to the tarsus are included in the tissue removed. A row of double armed sutures are then inserted into the lid, entering at the upper border of the wound and passed thru the cartilage in such a manner as to emerge at the inner margin of the lid at the ciliary border. The sutures are then carried downward and entered deeply in the lower wound margin and passed thru the skin. This produces a mattress-like suture which everts the margin of the entropionized lid after the two ends of the suture are tied. The author has had exceptionally good results following this operation and reports 17 cases upon which this method had been used. A plate which illustrates each step of the operation is included in the article.

Louwerier describes transplantation of a cutaneous flap from the lower lid into the retracted conjunctival sac in entropion of the lower lid. **Mattos** reports the cure of trichiasis and entropion after the method of Lagleyze, and **Trantas** describes an operation for relief of trichiasis and entropion.

ECTROPION. **Mertens** describes an infant in whom both upper lids were in a condition of ectropion at birth; the lids were restored to their normal position by bandaging. The number of such cases in literature is very small. Ichthyosis and hyperkeratosis have been held responsible for this trauma during birth. The reporter is unable to explain its occurrence in the case described.

Bayarri writes on the surgical treatment of inflammatory ectropion after Blanco's method.

Story reports a case of ectropion of the upper lid of seven years standing, in a man aged 21 years, caused by a fall on an iron bar, which had torn the upper lid and injured the upper border of the orbit. Following a previous operation, Story had operated on two occasions, seeking for necrosed bone or foreign body which would account for suppuration. At the second operation, the frontal sinus was fully exposed. The suppuration, however, ceased. A plastic operation had been done a dense mass of cicatrical tissue being first excised. This extended deep into the orbit and was attached to the roof well behind the orbital border. The lids were sutured together and a thick flap of skin and subcutaneous fat from the arm was inserted in the cavity. So far as could be judged, the result promised to be satisfactory.

In **Posey's** case, facial palsy with ectropion of the lower lid had resulted from disease of the superior maxillary bone in early childhood. The cosmetic deformity was considerable, but the chief cause of complaint was excessive lacrimation from the malposition of the lower lid. To correct this, thoro division of cicatricial bands, which bound down the margin of the lid to the lower orbital rim, was performed subcutaneously. Three sutures were then passed thru the ciliary border of the lid and the lid pulled as far upward as possible over the upper lid and secured in this elevated position by anchoring the sutures in the tissues just below the brow. To raise the inner canthus and to restore the functions of the lacrimal apparatus by bringing the punctum into apposition with the globe, a flap was taken from the root of the nose, after Hassner's method, and sewed into the tissues just subjacent to the lower lid margin, being superimposed upon an area which had been previously denuded of skin for its reception, the flap being so shaped and devised that it exerted an upward and inward traction upon the lid in the cicatrizing process. The sutures which dragged the lower lid upward were removed at the end of 10 days. Cosmetically the results of this double procedure were very fair. Lacrimation, however, persisted, and the palpebral portion of the lacrimal gland was removed without exercising any marked improvement on the tearing.

The entire gland was therefore removed.

In cases where the lower lid stands away from the globe, with or without slight ectropion of the lid margin, as occurs after recent burns and wounds and in elderly people, Hay aims to provide a sling with the aid of a pedicle flap taken from the loose tissue between the upper lid and the eyebrow (Figs. 6 and 7). The base of the flap is placed above a line drawn inwards from the internal canthus (or outwards from the external canthus). The height above the level depends upon the extent to which the lid has to be lifted; it is better to put it too high than too low, ¾ inch will meet an average case. From here the flap extends upwards, above and parallel to the principal fold of the upper lid, length and width corresponding to the size and character of the deficit to be remedied. From the base of the flap an incision is carried downward along the margin of the lower lid; the skin is freely undermined, care being taken to keep as near the surface as possible, and any cicatricial tissue is divided sufficiently to allow the lid to lie easily against the globe of the eye. Before turning the flap down into position, it is well

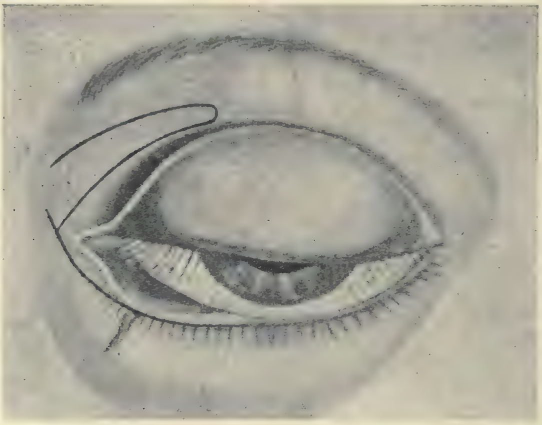

Fig. 6. Incisions for Hay's operation to correct slight ectropion of the lower lid.

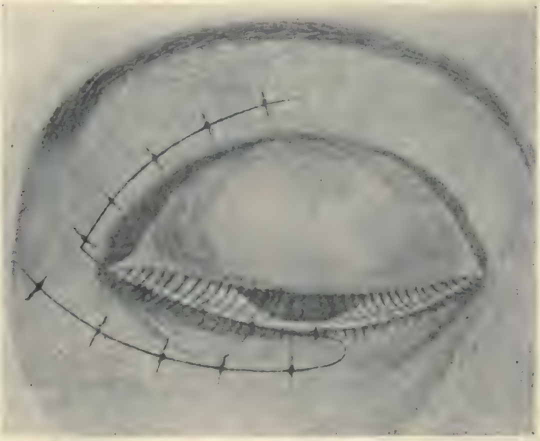

Fig. 7. Hay's operation for ectropion after tongue of skin has been shifted from under the brow to the lower lid, and sutures tied.

to incise it slightly on the lower side at the base, and to undermine the latter to facilitate turning. The flap should be kept thin to obviate an unsightly bulge when in its new position. Finally, the lid is hitched up, the flap put moderately on the stretch and sutured, silk near the lid margin, and horsehair and gossamer silk wormgut elsewhere. The operation can be applied to both ends simultaneously, if desired, and if necessary a continuous strip can be taken from the position indicated, with a base at each end, and brought down to form a complete new covering for the lower lid. (See Figs. 8 and 9.

Kuhnt considers as the method of choice in cicatricial ectropion the employment of pedunculated flaps from the cheek, temple and forehead, where no bone adherent cicatrices and no extensive superficial scarring are present. Complete excision of all cicatricial tissue and smoothing the wound surfaces is of the greatest importance. Folding of the lid forming flap, which has always been a just reproach to the method, can be readily avoided; it is simply necessary to suture the flap to

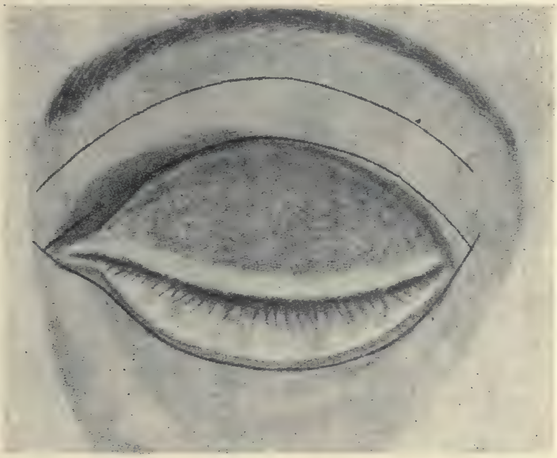

Fig. 8. Hay's operation for extensive ectropion of lower lid showing incision to be made to secure a flap from beneath the brow which can be transplanted to the lower lid, while still attached at both ends.

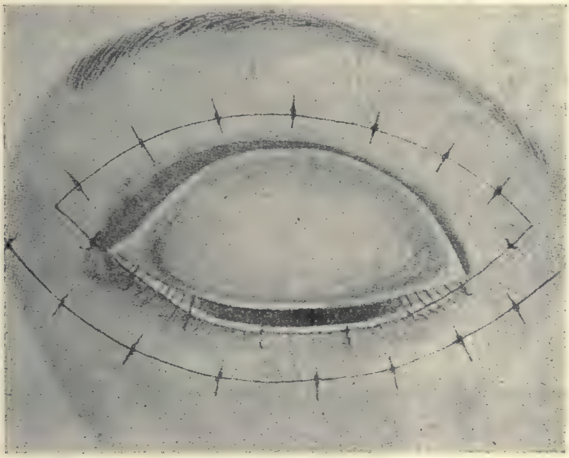

Fig. 9. Hay's operation for ectropion after the flap has been sutured in its new position and the denuded space closed by sutures.

the underlying surface—periosteum or other firm tissue—by a series of closely placed sutures and to so unite it with the adjacent skin as to carry the needles armed with double threads obliquely, that is about 3 mm. from the wound surfaces to the line of section of the epidermis. By this method of suturing the large wound surfaces of the flap are divided into several small sectors and so prevent the possibility of a drawing of the tissues toward the center. Covering the wound surfaces with nonpedunculated skin or Thiersch's flaps is recommended for all cases where there is no suitable skin in the neighborhood or where previous operation with pedunculated flaps has failed. The results are very satisfactory and permanent where the technic recommended by the author in previous publications has been carried out. Secondary ectropion from extensive cicatrices in the temple or cheek, is met by complete excision of the scars and suturing of the edges of the wound in such wise that the lids resume their normal position of themselves.

To remove the superfluous skin fold after Kuhnt's wedge-shaped excision of conjunctiva-tarsus, **Kölner** devised an incision in the skin of the lower lid, immediately below the cilia, and severing the ciliary margin on both ends of the incision, and then made the excision and placed the sutures. The incision of the skin is produced about 1 cm. parallel to, or better a little divergent from, the lid border; and a triangular piece of skin is excised as large as necessary to make the skin fold disappear. The skin is here undermined with scissors in order to leave the lid muscles intact.

Von Blaskovics discusses the shortcomings of Kuhnt's operation for ectropion and the different methods to correct them. He finally describes and recommends a method of his own, which is a combination of Kuhnt's methods with tarsectomy.

Quadras Bordes, discusses operation for cicatricial ectropion with implantation of small skin grafts by deWecker's method as successfully practiced by Blanco in numerous cases in his clinic in Valencia. In the case reported, there was ectropion of the lower lid, due to a cicatrix in the neighborhood of the lower orbital border; incision into the skin parallel to the canthus with retention of the same; mobilization of the lower lid thru a gaping anterior lid wall and suture of the freed lower lid canthus to the upper lid by wire sutures; grafting of the gaping skin defect of the lower lid by several small skin grafts taken from the arm, cut thin in an epidermic layer for covering the defect. The cicatricial ectropion in the case resulted from malignant pustule with chronic conjunctivitis. The reporter emphasizes the advantage of such plastic methods, as against flap formation from the skin of the face, in that no disfiguring operative cicatrices are left on the face.

SYMBLEPHARON.—Guided by Esser's method of preparing cicatricial conjunctival sacs for prothesis, and applying the same for the relief of symblepharon, **Friede** lays down the following three fundamental rules (1) the implanted flap must be firmly fixed either to the eyeball or the periosteum of the orbital margin or the skin of the lid; (2) all scar tissue must be thoroly excised in order to limit subsequent contraction of the flap as far as possible; (3) The newly formed conjunctival sac must be over large to meet the shrinking process. He reports a favorable result in a case in which all other methods had failed.

PLASTIC OPERATIONS.—**Tenner** reviews over 300 operations of resection of tarsus and conjunctiva (combined excision) performed by himself during 1919 and 1920 in the near East. He describes and figures a specially designed knife, lid forceps, mouse toothed and suture forceps used in the performance of the operation. He states the indications for the operation as follows: Active trachoma, with formation of cicatricial tissue, or where such formation is inevitable. If there is pannus, total excision should be performed to relieve the pannus; if there is no pannus, it should be done to prevent it. Local anesthesia is preferable except in children. The essential feature of the subconjunctival injections (Cocain, epinephrin) into the fornix is to cause ballooning into the fornix, thus dissecting the conjunctiva by fluid instead of by instruments and so preventing postoperative adhesions. The operation of combined incision should be restricted to the upper lid. The author believes that this operation offers the only means of rapid eradication of the disease and prevention of its complications and sequelae.

An extensive operation had been performed by **Butler** at the inner canthus for removal of a rodent ulcer which extended deeply and involved both lids. About one-third of each lid was removed and a large defect remained. The hemorrhage was violent and prolonged the operation. The defect was filled by a pedunculated flap from the forehead, which completely filled the gap; the lids were not obviously deformed and shut normally. The flap had become edematous and the kink on the nose was not beautiful. It was proposed to remove the base of the flap, which had now fulfilled its function and to pare down any redundant tissue. Butler had treated some of these cases with radium; but altho there was good superficial healing, the disease progressed under the skin and two of his patients had died. In one case, however, in which the whole inner surface of the lower lid was infiltrated with a rodent ulcer, one application of radium had effected a complete cure. Unless the ulcer were small and superficial, he would always excise it and remedy the resulting deformity by plastic operation.

Imre observes that the uncommon variety of defects of the eyelids and face, presented during the war, required extensive changes in methods of reconstruction that had hitherto been found adequate. His own method is to cover the skin defect from the immediate neighborhood without any real pedunculated flap. In order to be able to slide the greatest quantity of skin with the shortest possible wound, a curved cut must be utilized and the covering tissue slid in the shape of a bow. The curved incision should have the form of a quarter ellipse and about four times as long as the length of the necessary sliding. A small triangle of skin should be removed to make the sliding easier, as well as to prevent conspicuous elevations or wrinkles. Subcutaneous mobilization is of the utmost importance; where there is a great degree of defect in the fat and fascia, pedunculated flaps or flaps of fat and fascia are employed. In extensive defects a few catgut sutures are frequently necessary to fix the flap in its new place. When the sliding tissue is to form the inner corner of the lower lid, the edge of the flap is cut into two lamellae about 8 mm. long. The lamella should be fixed to the nasal ligament with catgut sutures, or, if the ligament is destroyed, directly to the periosteum, or the deep fascia. A number of cases with diagrams and photographs are described in detail. All these plastic operations, several hundred, were performed under local anesthesia (2% procain, and to every 10 cc. of solution, 6 drops of epinephrin solution). The after effects of procain, and those of shock, before and during the operation, can be avoided by half a gram of barbital.

Dubois thinks more attention should be paid to tarsorrhapy. He has performed the operation nine times on eight patients. When there is a permanent diseased condition tarsorrhapy at one of the angles serves well. He thinks the most important indications for the operation are paralytic ectropion from incurable facial paralysis and the exophthalmos of Graves' disease. Dubois operates under local anesthesia, following the method of Fuchs. In discussion Faber thought prolapsis bulbi should be added to the indications for tarsorrhapy. In a patient with Graves' disease and high myopia, who had developed prolapsis bulbi, he closed the aperture for about 1.5 cm. at the temporal side. In order to make the closure firm he slit the upper and lower lids and sutured the separate parts together.

In 1917 **Duverger** described a method for repairing wounds of the lids, which avoids the operative coloboma, necessarily produced when the free border is involved and the suture is placed in one plane only.

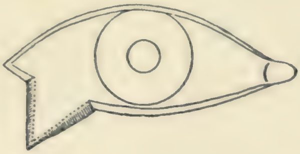

Fig. 10. Wound of lid near external angle freshened and trimmed for repair (Duverger).

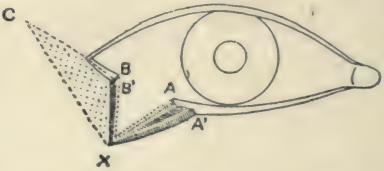

Fig. 11. B'C skin incision. B'X, incision in edge of wound. Skin disected up in C B'X, left attached along CX.

Repair of External Angle. When a wound involving the free border includes or comes very close to the external angle (2 to 5 mm.), it is very difficult or impossible to cover properly the very small extent of free margin of commissure. To obviate this difficulty, the author proceeds as follows: 1, Freshening and trimming the lips of the wound in the shape of a V (Fig. 10); 2. Cutaneous incision 2 to 3 mm. in length, obliquely from above downwards (in wounds of the lower lid which are most frequent) beginning exactly at the external angle; the inferior lip of the incision is dissected up and the incision continued in the free border so as to lift a triangular cutaneous flap with its margin adherent below and outwards; this flap is to form the cutaneous surface of the repaired lid; 3. The internal palpebral flap is easily made to the extent of about 4 mm. and the corresponding cutaneous triangle is excised (Fig. 11). Two triangular raw surfaces are thus obtained; a palpebral in front, inextensible, for it rests upon the tarsus, the other with skin surface back, much larger and extensible enough to cover the temporal plus the palpebral wound. 4. The tarsal surface is sutured with the knot in the conjunctival sac. The cutaneous surface is sutured after sliding the flap into the loss of substance in the temporal region (Fig. 13).

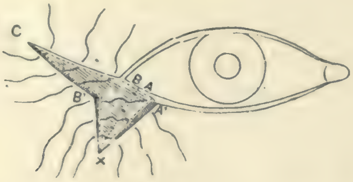

Fig. 12. Deep tissues including conjunctiva sutured, bringing B and A together. Skin sutures introduced.

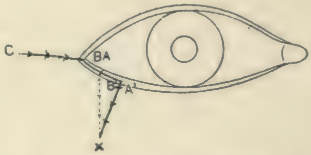

Fig. 13. All sutures tightened. X A line of union of deep tissues. X A' line of union of skin.

Repair of the Internal Angle. Wounds of the external angle, so frequent in war are much rarer in peace; but it is quite different with tears of the lower lid at the internal angle, which are extremely frequent and difficult of repair (Fig. 14). Tis technic for such wounds is as follows: 1. As ordinarily, freshening and trimming the margins of the wound; 2. Formation of the palpebral flap 6 or 8 mm. in size. A corresponding raw surface is made at the internal angle to receive the flap; (Fig. 15), 3. Sutures are suitably applied. (Fig. 16).

The final result is shown in Fig. 17.

Morax makes the interesting remark that the arch of the eyebrows, unlike the common belief that it has no other role than an aesthetic one, possesses a very useful function in that it prevents the entrance of the perspiration from the brow into the eye. In the case of a palpebro-frontal burn, the absence of such dam came out very unpleasantly and in fact, it was this which caused the patient to consult Morax. Autoplastic restoration may be accomplished by two different autoplastic methods; autoplasty by displacement of pedunculated, hair-bearing, cutaneous flaps taken from the maxillary region of the opposite side (in case of unilateral alopecia of the eyebrow) or from the temporo-frontal region. This method is extremely satisfactory in complete alopecia of both eyebrows; by its means, hair-bearing grafts can be obtained to any desired extent and of perfect symmetry. It is the method of choice whenever possible, that is where the temporo-frontal region has not been denuded of hair by cicatricial alopecia.

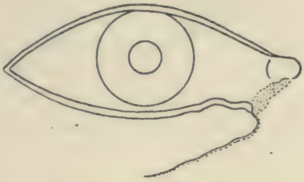

Fig. 14. Lacerated wound of lower lid near inner canthus (Duverger).

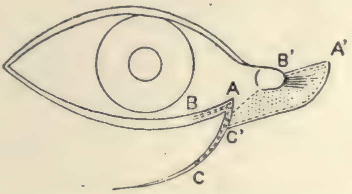

Fig. 15. Wound freshened and lid split at A B C, conjunctival layer is then excised.

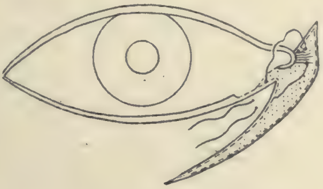

Fig. 16. Deep supporting suture passed under internal palpebral ligament, both ends emerging thru skin flap.

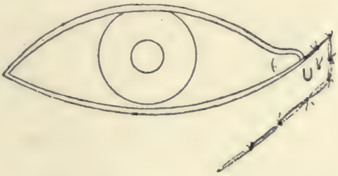

Fig. 17. All sutures introduced and tied, the deep supporting suture at U.

Autoplasty with nonpediculated hair bearing flaps may also give good results, but they are uncertain, and when successful, the number of hair follicles which survive transplantation is always greatly reduced as compared with the follicles originally present in the grafted tissue. This procedure, the technic of which is undoubtedly capable of improvement, may be applied where the neighboring hair-bearing regions (temporo-frontal, bearded cheek) have been deprived of their hair follicles or are not adapted to autoplasty with a pediculated flap.

In illustration of the above, the author reports four cases of autoplastic restoration of the eyebrows. In the first, there was absence of the external part of the left eyebrow and deficiency of the upper lid. The former was corrected by dividing the remaining part of the brow horizontally, leaving an external pedicle; the flap was then rotated 180 degrees, and sutured into a curvilinear incision made to receive it. The defect in the lid was corrected by a pedicled flap from the lower lid. In a case of burn there was a total alopecia of the eyebrow with double ectropion; the former was corrected by a flap from the scalp, which also somewhat relieved the ectropion, the remainder being corrected by a dermo-epidermal flap. In another case of bilateral total alopecia with bilateral ectropion and eversion of the conjunctiva, a nonpedicled flap was taken from the scalp of the occipital region, with a good result on the right side, but partial necrosis on the left. In a fourth case, the grafts took, but the hairs fell out and did not grow again.

Knapp had the opportunity of reexamining a patient upon whom he performed a plastic operation nine years before by reconstituting the lid margin with cartilage from the ear. He had split the cartilage and implanted a row of cilia taken from the eyebrow, over an extent of 1½ cm. where were found 34 cilia 2 to 3 cm. long which the patient had trimmed. The difficulty consists in getting cilia of the proper direction and retaining the hair follicles. The row of cilia had been implanted in a groove in the cartilage; sutures were not employed.

A *paraffinoma* of the lid is reported by **Bevan,** which had become a dense unyielding mass which prevented any opening of the eye. After removing all the paraffinoma of the lid Bevan covered the upper lid with two Thiersch grafts taken from the back of the left arm. He describes the technic of the operation.

Komoto describes an operation for restoration of a partially lacerated and improperly healed lid margin. In these cases, it not rarely happens that the upper lid margin is fairly torn away, and upon being sutured, unites in an improper position so that the configuration of the palpebral aperture is disfiguring. His operation is intended to correct this.

Kalt's procedure for restoration of the lower lids when totally destroyed, consists in taking a cutaneomucous flap from the cheek; this is sutured to the upper lid, after introduction into the cavity of a glass shell. An autoplasty with a pediculated flap is then made; from 4 to 6 months later the two flaps are united. An operation combining the Italian plastic with the Wölfler transplantation in lid defects is described by **Alexowski.** **Rollet** and **Bussy** describe blepharoplasty with a sliding flap.

In case of most extensive destruction of both lids with only irregular fold of skin remaining and complete disappearance of conjunctiva and cul-de-sacs, following injury from hot lead, requiring enucleation, **Wheeler** was able to obtain a presentable result. Skin had to be furnished for the marginal portions of the eyelids, a hair line had to be reconstituted in imitation of eyelashes for both upper and lower lids, the cul-de-sacs had to be restored so that an artificial eye could be worn and mobility of the stump secured. A first intervention to restore the marginal portion of the upper lid was made. After minute preparation for its reception, a graft 45 mm. long and 8 mm. wide in the center was dissected free from the lower part of the right brow and skin below it, care being taken to avoid injuring the hair follicles, and placed in its prepared bed, upside down, so that the hair line would be in proper position to mimic eyelashes. For the interesting account of the method of managing the graft, the original paper with diagrammatic illustrations should be consulted. Five days after the operation it was found that the graft had taken completely with the wound in good condition.

The second intervention consisted in restoration of the marginal portion of the lower eyelid after similar preparation, as in the case of the upper lid; a somewhat larger graft was taken from the lower part of the left eyebrow; the operative technic and postoperative care were the same as for the upper lid graft, and this graft also "took" completely. The cul-de-sacs were restored by means of Thiersch grafts, the raw surface outwards. After healing from the grafting operations, an artificial eye could be worn acceptably but the fissure was a little too long and the new-formed lid margins slightly uneven; by a simple plastic operation at the outer canthus, the palpebral fissure was shortened about 3 mm. and the lid margins were carefully trimmed. To fill in the socket and furnish as much motility of the stump as possible, fat was taken from the abdomen and implanted in the muscular cone. The final result, as shown by a photograph is excellent and well nigh unique, when the unpromising nature of the case is duly considered.

Kleefeld, to combat the deviation of the cilia in trachoma after extirpation of the tarsal cartilage, has reconstructed a solid framework for the lid as follows: Silk threads boiled in 4% sublimat solution are introduced into the tissues; these threads are not absorbed, but cause a lively reaction, resulting in very resistent newly formed sclerosed tissue.

After enucleation of the tarsus in trachoma, the upper lid loses its support and rolls in. In such a case, **Loewenstein** implanted a piece of cartilage taken without skin from the anterior surface of the helix. After a week the convex margin of the cartilage had turned up and caused an entropion, which was later corrected by operation. The eye was without irritation, pannus improved, vision 6/24. In future cases Loewenstein recommends sewing the levator tendon to the cartilage. **Esser** and **Meyer** also contribute to the literature of lid plastics.

The Orbit

W. L. Benedict, M.D., F.A.C.S.

ROCHESTER, MINN.

This section of the digest carries the literature from October, 1920, to August, 1921. For previous references see O. L., v. 16, 1920, p. 258.

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DIGEST OF THE LITERATURE.

ANATOMY. **Marx** studied the influence the shape of the head exercises on that of the orbit and the position of the eyes; and also the influence of the growing eye upon the orbit. If the coronal suture closes prematurely, a compensatory enlargement must take place, producing oxycephaly. If the sagittal suture closes too early, the scaphocephalic skull develops with an increase in length and height.

Another form exists which can be considered as a transition toward oxycephaly. Redslob reported a case in 1919. Marx reports a case in a child, especially afraid when some one attempts to touch his bulging eyes. The vision is 5/10, 1 D. hyperopic. The discs are somewhat indistinctly limited and gray. The forehead rises steeply and is asymmetric. The right side is flat, the left somewhat bulging. Over the glabella a crest begins to rise and extending over the sagittal suture is a frontal depression. The curved nose is convex to the right, the lips are thick, the eyes prominent, but the lids close well. The exophthalmos must be explained by the orbits being too short.

Marx examined 45 normal skulls, 8 scaphocephalic, 6 oxycephalic. The index which gives the relation of the orbital depth to the greatest length of the skull; medial orbital wall 100 gives an average for the normal left orbits, 414; for the right orbits, 411. In oxycephaly this index is: left 453, and right 450; and in scaphocephaly, 523 and 418 respectively. The latter indicated that the orbit did not take so great a part in the increased growth in the length of the skull as did other parts. The orbits in scaphocephaly are somewhat extended in breadth in comparison to the normal, still the orbit in oxycephalic skulls is about normal. But the entrance of the orbit in oxycephaly is smaller in its entirety; its height is reduced, left 1 mm., right 1.5 mm.; but its breadth has lost more, left 6.5 mm., right 5. mm. One must consider that the orbit is shorter than normal because of the backward development of the frontal bone, which explains the general smallness of the orbital opening.

A series of elaborate measurements of the skull and orbit of the Japanese have been made by **Onishi**, who publishes them in tabular form.

ANOMALIES. A case of congenital varicocele producing exophthalmos of the right eye of a girl six and one half years old is reported by **Fromaget.** **Hueber** found a transverse muscle in both orbits of an individual, differing from the case described by Bochdalek (1868). The muscle arose from the anterior part of the ethmoid plate as a flat tendon seven millimeters in width, merged with the levator and spread out to become attached to the outer wall of the orbit as a flat tendon twenty millimeters broad which was also fused with Tenon's capsule. The innervation of the muscles could not be determined as dissection of the orbit had been carried too far before the muscle was found. **Lapersonne** and his coworkers report that the exophthalmos in a girl fifteen years was explained by radioscopy as due to development of twelve or more supernumerary teeth in the face and orbit. The difficulties of operative removal of the teeth in the orbit have made them refrain from any intervention.

A congenital meningocele in a child of two years was reported by **Luz.** At autopsy it was shown that the meningeal sac accompanied by the optic nerve ended in a white shapeless mass, the atrophied globe. The orbit was completely deformed, the tumor coming out thru the much enlarged sphenoidal opening which allowed the passage of two fingers.

The case of meningoencephalocele of **Van Duyse** reported last year (Vol. 16, p. 261) has now appeared in the literature with full description of the operation and illustrations.

EXOPHTHALMOS. Unilateral postural exophthalmos of the right eye was found by **Crigler** in a man aged 34. He complained of a pain in the eye with protrusion of the globe when he bent over or stooped forward. While in the upright position there was no proptosis. Previous to the appearance of the proptosis he had suffered from frequent epistaxis. There had been no recurrence of nose bleed since the exophthalmos began. No cause for the condition was found. **Zade** has written on intermittent exophthalmos. His patient by stooping could cause the left eye to protrude 9 to 12 mm. Forced expiration and bending the head to the left caused less displacement.

Klestadt reported the history of a patient in whom a granuloma of the right upper first molar had caused an infiltration of the cheek and an empyema of the antrum of Highmore. These were followed suddenly several days later by exophthalmos and diplopia. At operation the walls of the antrum were found to be intact and there was no pus in the cheek. He believed that the inflammation must have travelled up along the outer side of the upper jaw. **Arrell** referred to a patient in which there was a slight paralysis of the sympathetic with slight exophthalmos. The basal metabolism was found to be normal. No cause for the exophthalmos was found. **Deelman** has written on exophthalmos, and **St. Martin** on false exophthalmos.

PULSATING EXOPHTHALMOS. The frequency of pulsating exophthalmos following trauma to the head is indicated in case reports by Wheeler, Posey (three cases), **Thompson** and **Thompson,** Swift, **Robineau,** Hartshorne, and **Poulard** and **Bailliart.** One case was reported by **Hallett** in which no cause was mentioned. Exophthalmos accompanied by head noises and bruit occurred immediately after the accident or was delayed for three months to four years. The exophthalmos in **Hartshorne's** case was due to rupture of the internal carotid into the cavernous sinus.

In **Swift's** case there was bilateral pulsating exophthalmos, paralysis of both sides of the face, and of the second, third, fourth, fifth, sixth, and seventh cranial nerves, but no fracture of the skull could be demonstrated by roentgenogram. Vision was reduced to ability to count fingers at six feet. Recovery followed ligation of the right internal carotid artery and vision was increased in the right eye to 3/10; vision of the left eye was unchanged.

That exophthalmos may be long delayed following accident is shown by the case reported by **Wheeler.** A male, age 31, was injured in a motorcycle accident. Transient right facial paralysis and right ptosis followed the accident. Recovery from both was complete, but a diplopia resulted which lasted six or seven months. Two years later, following physical exertion, there occurred diplopia which persisted for six weeks. After another two years he contracted pneumonia and during recovery developed diplopia again, this time accompanied by a bruit. Both diplopia and the bruit persisted from that time on. Vision equalled 20/20 in each eye. There were four millimeters of proptosis of the left eye and dilatation of the conjunctival vessels of both eyes. The proptosis was not increased by bending forward. There was enlargement of the retinal veins in the left eye. An enlargement of the sella with erosion of the dorsum behind, and the base of the posterior clinoid, was demonstrated by a roentgenogram, showing that pressure was being exerted down and back.

Compression of one carotid artery usually controlled the bruit in these cases. Ligation of the right internal carotid was followed by recovery in Swift's case, and in two of the cases reported by **Posey.** One of Posey's cases died of cerebral softening and Dr. Martin, who had performed the ligation in these cases is quoted by Posey as follows: "In the adult complete ligation of a single carotid is followed by cerebral softening in such a large percentage of cases that the operation is attended by an almost prohibitive risk. The success attending the treatment suggests that a partial ligation of one carotid to the point of stopping the pulsation bruit is a safer method than complete ligation, and may be equally efficacious."

Sattler reports five cases, four of which were traumatic, three accompanying fracture of the skull. The intraocular tension was not above normal and was greatly depressed by pressure on the carotid. He gives a partial review of the literature.

In **Hallett's** case the left common carotid artery was ligated after which the angular ophthalmic vein was ligated at the inner margin of the orbit, completely controlling the bruit. A month later the bruit gradually appeared on the other side of the head with pulsating exophthalmos of the right eye. Experimental digital compression of the right carotid artery caused coma. No further surgery was proposed and death occurred shortly thereafter. Hallett's case recovered with preservation of vision, following ligation of the common carotid artery. **Erggelet** has written on pulsating exophthalmos.

The case reported by **Robineau** was operated by **Cauchois** who ligated first one and then the other common carotid with satisfactory result. He believes that ligation of both common carotids is no more dangerous than of one, provided five or six weeks elapse between the operations. Likewise Poulard and Bailliart's case of pulsating exophthalmos of the right eye following fracture of the skull recovered following ligation of both common carotid arteries. The exophthalmos persisted but the headache stopped. The pupil of the affected eye was dilated and immobile to light stimulation but responded to pilocarpin and eserin.

An arteriovenous aneurism between the left internal carotid artery and the cavernous sinus in a woman 73 years of age was studied and reported by **Ruttin**. The first symptom noticed was a paresis of the abducens and later a slight exophthalmos. The conjunctival veins in the lower fornix and the scleral and retinal veins were distended. The venous congestion increased and hemorrhages were noted on the disc and chemosis of the conjunctiva occurred. The intraocular tension, when first seen, was slightly elevated. It gradually increased but varied at different times, the maximum being 60 mm. of Hg. A murmur was audible over the whole head.

EXOPHTHALMIC GOITER. **Schulte** reviews the literature of the last five years on this subject. He shows that the thyroid is no longer regarded as exclusively responsible for this disease. It is the most important link in the chain, but other ductless glands may be involved. The latter, however, usually return to normal functioning when the influence of the thyroid is removed. A review of our knowledge on this subject is given by Brelet. Among the symptoms mentioned are the oculocardiac exaggerated in 60%, decreased in 10%, normal in 30%. Gifford's sign is mentioned. The frontal sign is described as an immobility of the frontalis when looking upwards or a delay in the contraction of the frontalis. He notes the occasional appearance of four striae of congestion corresponding to the positions of the recti muscles, and classifies this as an early symptom. Pupillary disturbances are rare as is spontaneous nystagmus. Provoked nystagmus is present in one-third of the cases. Ocular palsies are rare and when present indicate a complication such as syphilis or tabes. **Claiborne** thinks that the proptosis in exophthalmic goiter is due to congestion within the orbit, excessive fat, and hyperplasia of all orbital structures. **Moore** found the muscles of the orbit soft and edematous (the fat was edematous) greatly swollen fusiform bellies, apparently from edematous infiltration. In the case described by **Pasman** and **Mestre** exophthalmic goiter had developed in the course of pregnancy and the condition became very grave at the sixth month. Evacuation of the uterus was followed by retrogression of the clinical picture. **Sainton** discussed the various signs found in exophthalmic goiter.

Marine writes of the physiology of the thyroid in exophthalmic goiter. In his experience the essential cause of exophthalmic goiter must be sought for outside the thyroid. A manifestation of thyroid insufficiency is the occurrence of congenital goiter in babies born of mothers with active exophthalmic goiter.

Crotti takes up the treatment and prevention of exophthalmic goiter and concludes that more attention must be paid to focal infections; that it is a disease where the internist and surgeon must work together. **Hoover** considers the medical problems in the treatment of exophthalmic goiter, and **Delbet** takes up the surgical intervention in Basedow's or Graves' disease. He thinks we can do one of two things; ligate the thyroid arteries two or three at a time, or we can repeatedly resect or partially resect the gland, until the desired effect is obtained. These operations attenuate tachycardia and tremor, but are without influence on the exophthalmos. **Dragozzi** also takes up the treament of exophthalmic goiter as follows: 1. Drug therapy, 2. Serum therapy, 3. Hydrotherapy, chemothrapy and massage; 4. Electrotherapy. 5. X-ray and radium, and 6. Surgical treatment.

Crance reports in detail the case of a girl aged 16 with exophthalmic goiter. Ligation was done followed by good results and thyroidectomy was considered but was delayed on account of the extreme nervousness of the patient. Death occurred after about six months. Crance considers the condition due to focal infection and thinks vascular ligation should always be followed up with thyroidectomy.

Johnson gives a clinical classification of exophthalmic goiter. He thinks surgical treatment must often be resorted to, but agrees that medical treatment is of great value.

Vipond reports the case of a girl of 14 with exophthalmic goiter who had cardiac murmurs as well as in the carotid arteries. On placing the stethoscope over the closed eye he detected the same systolic murmur met with in other areas. He has found this murmur in the orbit in cases of advanced heart disease, but never in patients with a normal heart.

Schulte states that operative reduction of the thyroid has gained ground in recent years. The improvement realized is prompt and more permanent than with internal measures, in which the mortality does not seem any greater than with the latter. **Frazier** advocates early ligation followed by thyroidectomy. **Judd** calls attention to the difference between hyperthyroidism and Plummer's disease, and states that operation for exophthalmic goiter should not be undertaken while the patient is growing rapidly and progressively worse, but that rest and elimination and steady diet should be prescribed, hot water and urea injections carried out till the crisis is passed, then thyroidectomy done. He reports exophthalmus as present in 70% of the cases.

At the University Clinic at Königsburg, **Klewitz** states that nonoperative treatment is not considered for exophthalmic goiter when malignant degeneration is suspected, in colloidal or cystic degeneration or when the goiter is causing symptoms from pressure on the trachea or esophagus, nor in general in old chronic cases. The cases selected for nonoperative treatment are the abortive cases, the acute or subacute cases, cases with cardiac insufficiency or other complications that make intervention seem inadvisable, and finally, cases in which an unsuccessful operation has already been performed, or operation has been absolutely refused.

Stierlin and **Meyenburg** report wide spread paralysis following ligation in a 23 year old girl who had exophthalmic goiter. Lid signs of exophthalmic goiter were not present. Following ligation of the right superior thyroid artery and right inferior thyroid artery she developed a rapid pulse and four days later leftsided paralysis of the face and arm and leg with loss of sensation. The head and eyes were drawn to the right. She died on the sixth day. Autopsy revealed postoperative thrombosis of the right superior and inferior thyroid arteries, the common and internal carotid arteries and the medial cerebral artery.

Bram discusses in great detail the basis for selection of cases for operation and thinks that many cases do better if not operated. The danger of tetany from ligation of all four arteries of the thyroid has rendered surgeons wary with this as it seems to cut off nourishment from the parathyroids. **Schiassi** reviews the ultimate outcome in three cases treated by sympathectomy at the Bologna Policlinic with recovery of only one; in six treated by ligation of the thyroid arteries with recovery of only 50%; and 28 cases treated by thyroidectomy with complete and permanent recovery in 100%. Of those treated by medical measures alone during the last 15 years, from 35% to 40% have died.

Various methods of nonoperative treatment are described by various writers. **Klewitz** thought he saw good effects from the serum of thyroidectomized rams when combined with other measures, but he thinks that deep Roentgen therapy may possibly establish a claim to casual treatment. There is a difference of opinion as to how Roentgen therapy "works." Some think it checks the functioning of the cells of the thyroid and then prevents an over production of the glandular secretion. Roentgen therapy was tried in some of Schiassi's cases after failure of other non operative measures. Few showed any benefit and one patient complained oi aggravation. **Schulte** says of Roentgen ray treatment that it renders operative measures more difficult if they finally have to be applied, that fatalities have been reported, and also the transformation of an exophthalmic goiter into a myxedema. **Barker** gives the technic for administration of Roentgen ray for exophthalmic goiter and states the indications as well as the contradictions for its use. Various forms of organic therapy have been tried but for the most part have been disappointing. **Crile** sums up the surgical problem in the management of exophthalmic goiter as follows: 1. Elimination of the excitants of metabolism before, during, and after operation. 2. Protection of the internal respiration. 3. Maintenance of an adequate water equilibrium.

ENOPTHALMOS. **Pichler** adds the clinical histories and autopsies of 2 cases of enophthalmus to his 3 already published. The postmortem examinations revealed in the first case, after a severe contusion of the left half of the face, 7 months previously, atrophy of the medial and inferior orbital margins and of the fat of the orbit. In the second case, also after a fall on the left side of the head 17 years before, a marked atrophy of the orbital fat. The enophthalmus in all 5 cases was due to great atrophy of the orbital fat, from trophic disturbances.

ORBITAL PHLEGMON. **Rollet** and **Bussy** emphasize the difference in cause, treatment and prognosis between phlegmon of the orbit and phlegmon of the eye. No one dies from the latter but the eye is lost. From phlegmon in the orbit the eye need not be lost but one may die. They state that in cases of orbital phlegmon the frontal sinus should be exposed, as frontal sinuitis may induce phlegmon of the orbit by the spreading of infection by veins and lymphatics thru apparently sound bone. They believe that the sphenoidal sinus is scarcely ever responsible for phlegmon in the orbit, but an infectious process in the maxillary sinus is very likely to spread to the orbit. **McMillan** reports 8 cases of orbital cellulitis, four of which came on during scarlet fever, three in erysipelas, and one in puerperal fever. He mentions a ninth case of cellulitis from venous sinus thrombosis in a patient who was suffering from cerebro-spinal fever. Of the eight cases seen in five years two died, one had the affected eye enucleated, and three had total or partial loss of sight; another recovered with ptosis and one was still in the hospital. **McClelland** adds the case of a child three years old who recovered with a slight strabismus, but visual acuity of 6/36. **Todd's** case recovered with a perfectly normal eye following incision and drainage of the orbit. Exenteration of the orbit during the progress of phlegmon was followed by purulent thrombosis of the cavernous sinuses in cases reported by **Schwarzkopff** and by **Wick**. The latter states that transmission of cellulitis from one orbit to the other does not always take place thru the cavernous sinus, but may occur thru the transverse anastomosis between the frontal and ethmoidal veins.

An inflammatory pseudotumor of the orbit was operated by **Huber.** A young soldier, age 20, noticed in June 1917, sudden failure of sight of the left eye and severe pain. When seen by Huber a year later the vision of the eye was nil. The eye deviated downwards and to the temporal side and was proptosed. Exenteration of the right orbit was done after administration of potassium iodid had been tried and found to produce no change. The orbital content consisted of coarse fibrillar tissue, with scanty vessels and cells, scattered plasma cells and lymphocytes, at some places conglomerated to heaps similar to lymph follicles. **Danis** reports phlegmon after influenzal pneumonia, **Decrocq** phlegmon with frontal sinuitis, and **Seeman** writes on orbital phlegmon. **Ruiz** reports orbital inflammation following grippe. **Larsen** reports orbital abscess following abscess of tooth.

CYST OF THE ORBIT. A case of echinococcus of the orbit is reported by **Corrasco.** The patient, a woman of 30, had noticed for three months a gradual decrease in the sight of the right eye, with pain in the right orbit. This was followed by a gradually increasing exophthalmos. When seen, there was an extreme exophthalmos with intense edema of the conjunctiva. The eyeball was the size of a mandarin, and the cornea showed a central ulcer ready to perforate, with infiltration of the margins of the cornea. A large cyst could be felt external to the ball, and puncture yielded a fluid with the characteristic reaction for echinococcus. During the operation, the cornea ruptured with extrusion of the lens and some vitreous, but the vesicle was extracted in toto. It had a diameter of 5 cm. Healing was complete in four days.

Carrere and **Tiscornia** report hydatid cyst of the orbit.

SYPHILIS. Two cases of orbital syphilis were reported by **Raffin.** The first case occured in a woman, 22 years of age, and involved the rim of the left orbit above. A mass the size of a hazel nut was found adherent to the periosteum. A slight ptosis of the upper lid and a divergence of the left eye were also noticed. In the second case the rim of the orbit was involved and a purulent dacryocystitis was present also. Both cases improved rapidly under antisyphilitic treatment. The author briefly discusses the literature on the subject.

TENONITIS. Following a severe fit of coughing in a case reported by **Terlinck,** there was a sudden diminution of vision of one eye, followed in two days by amblyopia. Examination showed exophthalmos, chemosis of the conjunctiva, discoloration of the iris, dilated immovable pupil, severe subconjunctival swelling. The fundus could not be seen. An incision over the insertion of the internal rectus yielded a seropurulent fluid, and a platinum wire inserted into the opening could be moved freely in Tenon's capsule. The symptoms gradually improved.

ORBITAL CELLULITIS AND SINUS DISEASE INVOLVING THE ORBIT. That suppuration in the nasal accessory sinuses is a frequent cause of cellulitis in the orbit is shown by reports from widely situated localities. **Wright** has seen six cases of orbital cellulitis in the Government Ophthalmic Hospital in Madras, all due to frontal sinus disease. In one case there was gumma of the orbit and frontal sinus. **Bachmann** described four cases of involvement of the orbit in connection with operative procedures on infected sinuses or lacrimal apparatus. All recovered following incision and drainage of the orbit, with marked visual loss in only one case. A case of primary purulent frontal and ethmoidal sinuitis reported by **Blake,** developed abscess of the frontal lobe of the brain, localized purulent meningitis, epidural, periorbital and subcutaneous phlegmon. The orbit was incised but death occurred shortly after. The longitudinal sinus was found to be filled with clot.

In the two cases reported by **Camison** disease of the frontal sinus produced in one phlegmon of the orbit and in the other suppurative periosteitis with great swelling of the upper lid.

Diseases of the nasal accessory sinuses and of the optic nerve is the subject of a comprehensive but incomplete review of the literature on the subject by **Brückner.** He states that most of the cases are caused by affections of sphenoid or posterior ethmoidal cells and lays stress on the rapidity of the development of a central scotoma and increase in the size of the blind spot as differential points in the diagnosis of acute and chronic retrobulbar neuritis.

Sinus Thrombosis. Thrombosis complicating otitis media is reported by two writers. **Herzig's** case was a child that became ill with a temperature of 102. For five days the temperature fluctuated between 101.2° and 104°. Swelling of the lids of the right eye was noticed, followed by right exophthalmos. Otitis media was discovered and the membrane incised, followed by escape of a brownish fluid from which staphylococcus citrus was grown. An operation thru the orbital cavity into the ethmoid region evacuated large quantities of pus. Cavernous sinus thrombosis was found after death. From the time the eye became proptosed until death took place only thirty hours had elapsed.

Blake's case also was in a child, at 3½ years. The brain at autopsy contained a thrombus in the left lateral sinus which extended back into the straight sinus and into the posterior part of the longitudinal sinus. Both cavernous sinuses were filled with a thrombus.

Charlin describes four cases. The symptoms common to all were high temperature, bilateral exophthalmos and meningoencephalic symptoms such as delirium, somnolence, coma, violent headaches, contractures, positive Kernig and changes in the cerebrospinal fluid. The latter symptoms varied with the cases. In one case the ophthalmoscopic examination was negative. In two there was a slight increase in the papillary blood supply. In one the vessels were at first very small and empty, but later were slightly dilated. The pupils were small in all cases, usually not giving the ordinary reactions. In two cases there were paralysis of the extraocular muscles. A case of traumatic rupture of the internal carotid artery into the cavernous sinus producing an arteriovenous aneurysm is reported by **Hartshorne.** Arteriovenous aneurysm of common carotid and sinus in relation to exophthalmos is reported by **Seyfarth.**

Schwartzkopff reports a case of orbital phlegmon caused by a beard of grain which stuck into the right eye. Drainage was established by incision but two days later the orbit was exenterated. The patient died three days afterward. Autopsy revealed purulent thrombosis of the cavernous sinus by thrombophlebitis of the orbital veins and circumscribed basal meningitis at the chiasm.

Bilateral thrombosis of the cavernous sinuses following orbital phlegmon without known cause is reported by **Wick.** The right orbit was exenterated and death occurred 78 hours after the onset of the disease. The propagation of the thrombophlebitis to the cavernous sinus was easily demonstrated. **Blake** reports a case of otitis media causing infected thrombi in both cavernous sinuses and in the left lateral, straight, and longitudinal sinuses, and acute cerebral meningitis.

Fenton reports a case of bilateral thrombosis of the lateral sinuses with orbital involvement in a young man aged 19 with a history of incessant swimming and high diving. An extensive Luc-Hajek external frontal operation was unsuccessful and death occurred on the 27th day. Postmortem revealed an orbital abscess extending vertically 8 cm. from the left orbital wall. Hemolytic streptococcus was the chief organism found in the pus. The literature shows only a few similar cases reported.

Couette made a histologic study in Rollet's clinic of the lesions of eye, orbit, sinuses and meninges at the base of the brain, in orbital thrombophlebitis; and describes in detail the lesions of the choroid, retina, pituitary gland, etc., connected with this affection. **Bourland** reports a case of unknown cause and sudden onset.

OPERATIONS. The technic of an operation for frontal mucocele is given by **Morax.** Under local anesthesia, he made a cutaneous incision at the level of the eyebrow. The periosteum was turned back and the mucocele incised. The wall of the frontal sinus being opened for the purpose to an extent of 6 mm. thru the opening made by trephining, he introduced a small perforated silver drain, terminating at its upper end in a thread of silver. The lips of the wound were sutured together with this thread passing between them. The drain was drawn out by this silver thread on the 6th day. There was no recurrence of the mococele.

Vail reports exophthalmos and third nerve palsy due to empyema of the posterior ethmoidal sinus cured by intranasal operation in a man, aged 50. Suction treatment, withdrawing an amount of yellow pus always gave relief; but operation was resorted to, followed by prompt recovery. The condition was thought to be a subperiosteal abscess which had broken thru the orbit wall.

Pockley presented a child on whom he had performed a successful Krönlein operation. The ptosis had practically disappeared and the eye was almost normal.

What may prove to be a very useful operation is described by **Moore.** He reports the case of a woman of 53 years who had Graves' disease with exophthalmos. To reduce the proptosis he made an incision thru the whole length of the lower fornix and picked away a teaspoonful of fat, then sewed the lids partly together. Both eyes were saved.

Magruder transplanted fat from the abdomen to the orbit following enucleation and reports that both wounds became infected. The patient later stated that any scratch on the body would lead to pus formation.

RESTORATION OF OBLITERATED EYE SOCKET. The use of some modified form of Esser graft is giving most satisfaction and is advocated by many surgeons. **Roy** reports satisfactory restoration by means of Thiersch grafts held in place by lead moulds, while **Gillies** uses Esser's epithelial inlay. **Wheeler** mentions the difficulties encountered in the use of the Weeks, Morax, and Maxwell operations, and gives an excellent description of his own technic which he states, is not altogether original with him. The operation consists of the preparation of a bed to receive a stent of dental compound about which is wrapped a piece of thin epidermis taken from an arm or leg. An incision is made to separate the lid margins, if they are adherent, and the dissection is carried on in such a way as to separate the lids from the orbital contents. A free canthotomy is made extending from the outer canthus to the outer orbital margin and an incision to the margin of the orbit or one or two mm. beyond. No sutures are used, but the graft is held in position by pressure bandage which is left in place for a week. The stent is removed after three weeks. A week or more is allowed to elapse after removal of the stent before a prothesis is inserted. Gillies, however, in describing his operation, states that the grafted sulcus must be kept fully stretched for a considerable time after operation and he uses a vulcanite model for about three months for this purpose.

Knappstein writes upon reconstruction of socket for artificial eye in total or partial loss of conjunctiva.

Henderson reports a series of contracted sockets and bands in socket now wearing artificial eyes after the "suture operation" as described by him two years ago. (See v. 15, p. 253).

Current Literature

These are the titles of papers bearing on ophthalmology received in the last three months. Later most of them will be noticed under Digest of the Literature. They are given in English, some modified to indicate more clearly their subjects. They are grouped under appropriate heads, and in each group aranged alphabetically usually by the autnor's name in **heavy-face type.** The abbreviations mean: (Ill.) illustrations; (Pl.) plates; (Col. Pl.) colored plates. Abst. shows it is an abstract of the original article. (Bibl.) means bibliography and (Dis.) discussion published with a paper. Under repeated titles are given additional references to papers already noticed. To secure early mention copies of papers or reprints should be sent to 318 Majestic Building, Denver, Colorado.

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